Fiscal Federalism Issues in Resource-Rich Federations

by

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Outline

To consider issues that arise in a decentralized federation with a large regionally based nonrenewable resource sector

Draw on the literatures on fiscal federalism, economic geography and natural resources, especially the resource curse

Begin with a policy-oriented outline of the issues

Then turn to a brief illustrative theoretical model

Finally, discuss the application to Canada

Context: Long-Run Perspective of a Federation

From an economic point of view, regions federate to:

- Become economic unions with rights of residency anywhere
- Become social unions with social citizenship benefits
- Take advantage of scale economies in providing public goods and services
- Obtain mutual insurance against regional shocks via
  - National individual tax-transfer system
  - National social insurance programs
  - Interprovincial transfers
  - Migration
- Regional insurance role relies on
  - the federal government and, given longevity of shocks,
  - the constitution as a commitment device

Focus on Long-Run Regional Resource 'Shocks'

Economic Challenges in Decentralized Federations with Large Natural Resource Sectors

Possibility of resource curse

- Exploitation of natural resources in some regions accompanied by stagnation of manufacturing and other sectors elsewhere
- Declining sectors most innovative & productive-enhancing
- Mechanisms to adjust to shocks eroded:
  Excessive pressure on interstate migration

Effects magnified when states claim resource rents

- Development of natural resources may be too rapid
- Capture too small a proportion of rents, too inefficiently, and save too little for future generations
- Incentive to use the rents for state development and diversification at the expense of other states,
- Incentives for inefficient migration if rents not equalized

Primer on Resource Curse

- Classic Corden-Neary static trade model identified two effects
  - Spending effect: Export of resources and spending of proceeds leads to exchange rate appreciation and decline of manufacturing in favour of non-traded goods
  - Resource movement effect: L, K reallocate to resource production from manufacturing and non-traded goods
- Spending effect larger to extent that resource firms domestically owned and government spends revenues
- Timing of exchange rate affected by capital account changes from FDI: initial appreciation, later depreciation
- Resource-movement effect mitigated by immigration flows into resource-sector

Two Aspects of Resource Curse

1. Real resource flows from natural resource shocks
   - Interindustry and interregional labour and capital flows
   - Effects like any other terms-of-trade shock, except for possible dynamic inefficiencies discussed below
2. Creation & disposition of resource rents: unique to resources
   - Requires efficient management and taxation of resources
   - And, judicious use of resource rents

In principle, benefits of resource shock can be spread widely and all regions of federation can gain

- Adjustment mechanisms can absorb and insure shocks
- Management of rents can mitigate the size of shocks and spread the benefits

Welfare Effects of Resource Curse: Efficiency

- Reallocation from core to periphery reduces agglomeration and learning-by-doing externality benefits in core (Krugman)
- In long run, reallocation from high-productivity to low-productivity growth sector reduces overall growth rate (Sachs-Warner)
- Volatility of resource prices transferred to manufacturing via exchange rate, leading to uninsured risk
- Fiscally induced migration and excessive province-building expenditures, since rents accrue to states

Welfare Effects of Resource Curse: Equity/Insurance

- Redistribution to workers in resource-rich regions from workers in tradable sector
- Structural unemployment, perhaps transient
- Fiscal inequity in state public services net-of-taxes reflected in horizontal imbalance across states
- Difficulty of federal tax-transfer system and equalization & block transfers to cope

An Illustrative Model

- Natural resource extraction problem in multi-region setting
- Federalism combined with economic geography à la Krugman
- Relation between resource production, labour allocation and aggregate income in an economy with different regional specializations
- Examine whether decentralization of resource production and taxation makes it more likely that resource extraction leads to lower income by loss of agglomeration benefits
- Study effect of decentralization on resource extraction and migration, ignoring use of resource revenues and governance issues (rent-seeking, corruption, conflict)
- Limit analysis to efficiency, not equity or social insurance: Once-over shock; homogeneous households

Key Features

Resource extraction and regional development in a dynamic setting

- Decentralized natural resource management and taxation
- Three sectors, two regions
  - Resources and agriculture in one region (Krugman's Periphery)
  - Manufacturing with increasing returns in other (Core)
- Imperfect interregional labour mobility: takes time to move

Main messages

- Multiple equilibrium allocations of labour:
  Agglomeration non-convexity
- Decentralization leads to inefficiently high extraction rate
  Convergence to low-income equilibrium more likely
- Optimal extraction: Modified Hotelling Rule takes account of effect of extraction on interregional labour allocation

Related Literature

- Resource extraction and long-run growth: Krugman *JDE* 1987, *JPE* 1991; Sachs & Warner *JDE* 1999, *EER* 2001; Corden & Neary *EJ* 1982; van der Ploeg *JEL* 2011
- Fiscal federalism and efficiency in geographical allocation of labour: Flatters, Henderson & Miezskowski *JPubE* 1973; Boadway & Flatters *CJE* 1982; Gordon *QJE* 1983; Albouy *JPubE* 2012
- Multiple equilibrium allocations of labour in the presence of agglomeration effects: Mitsui & Sato *JPubE* 2001; Baldwin & Krugman *EER* 2004; Bucovetsky *JPubE* 2005

The Model

Two regions

- Region M: Manufacturing region
- Region R: Natural resource region

Region M

- Two potential manufacturing technologies: traditional technology with constant returns to scale or modern technology with increasing returns
- Modern technology requires public infrastructure financed by labour income tax; adopted if the manufacturing sector reaches a minimum size
- Manufacturing goods are tradable at fixed world prices $= 1$

The Model, continued

Region R

- Natural resource and agricultural sectors
- Natural resource is nonrenewable and all sold on international markets at fixed world price
- Resource extraction controlled by government of region R
- Agricultural output constant returns to scale and traded across regions only

Perfect labour mobility between the traditional and modern technology in region M, and between services and natural resource sectors in region R

Manufacturing Sector in Region M

Traditional technology

- Output at time t $X_t = \mu L_t^M$, where L_t^M is labour in region M
- Given unit price of X_t, competitive wage rate $\tilde{w}_t^M = \mu$

Modern technology (Krugman 1991, Sachs-Warner 1999)

- Final goods X_t produced using continuum of intermediate goods x_t^i:

$$X_t = \left(\int^{N_t} \left(x_t^i\right)^\sigma di \right)^{\frac{1}{\sigma}} G_t^\alpha, \qquad 0 < \rho, \alpha < 1$$

- Number of intermediate goods N_t determined endogenously
- Monopolistic competition and instantaneous free entry
- G_t = level of public infrastructure provided in region M

Manufacturing Sector in Region M, continued

Production of intermediate goods requires labour ℓ_t^i:

$$\ell_t^i = a x_t^i + b$$

$\Longrightarrow$ average costs declining in x_t^i

Demand for intermediate goods at time t solves:

$$\max_{\{x_t^i\}} \quad \left(\int^{N_t} \left(x_t^i\right)^\sigma di \right)^{\frac{1}{\sigma}} G_t^\alpha - \int^{N_t} p_t^i x_t^i di$$

- $p_t^i =$ price of the ith intermediate good
- Demand for x_t^i is increasing in G_t and decreasing in p_i

Free entry drives profits of intermediate goods producers driven to zero and determines number of intermediate goods

Manufacturing Sector Equilibrium

All inputs have same equilibrium price: $p_t^* = \frac{a}{\sigma} w_t^M$

- $x_t^i = x_t = \overline{x}$ and $\ell_t^i = \ell_t$ for all i
- Number on intermediate goods $N_t = \frac{1-\sigma}{b} L_t^M$

Labour market equilibrium determines wage rate:

$$w_t^M(L_t^M, G_t) = \frac{\sigma}{a}\left(\frac{1-\sigma}{b}\right)^{\frac{1-\sigma}{\sigma}} G_t^{\alpha} \left(L_t^M\right)^{\frac{1-\sigma}{\sigma}} \equiv D G_t^{\alpha} \left(L_t^M\right)^{\frac{1-\sigma}{\sigma}}$$

- w_t^M increasing in labour force L_t^M (economies of scale)

Manufacturing production: $X_t = w_t^M(L_t^M, G_t) L_t^M$

Government budget: $G_t = \tau_M w_t^M L_t^M = \tau_M X_t$, so:

$$w_t^M = D^{\frac{1}{1-\alpha}} \tau_M^{\frac{\alpha}{1-\alpha}} \left(L_t^M\right)^{\frac{1}{\sigma(1-\alpha)}-1}$$

Assume $0 \; < \; 1/\big(\sigma(1-\alpha)\big) - 1 \; < \; 1$

Manufacturing Sector Equilibrium, continued

Manufacturing operates under modern technology if:

$$(1-\tau_M)w_t^M \geqslant \mu = \tilde{w}_t^M$$

- Satisfied with equality at $L_t^M = \hat{L}^M(\tau_M)$
- Region M uses modern technology if $L_t^M \geqslant \hat{L}_t^M$
- w_t^M increasing and concave in L_t^M for $L_t^M > \hat{L}^M$

After-tax income region M:

$$I_t^M = \mu \quad \text{if} \quad L_t^M < \hat{L}^M$$

$$I_t^M = (1-\tau_M)w_t^M(\tau_M, L_t^M) \quad \text{if} \quad L_t^M \geqslant \hat{L}^M$$

SEE FIGURE 1

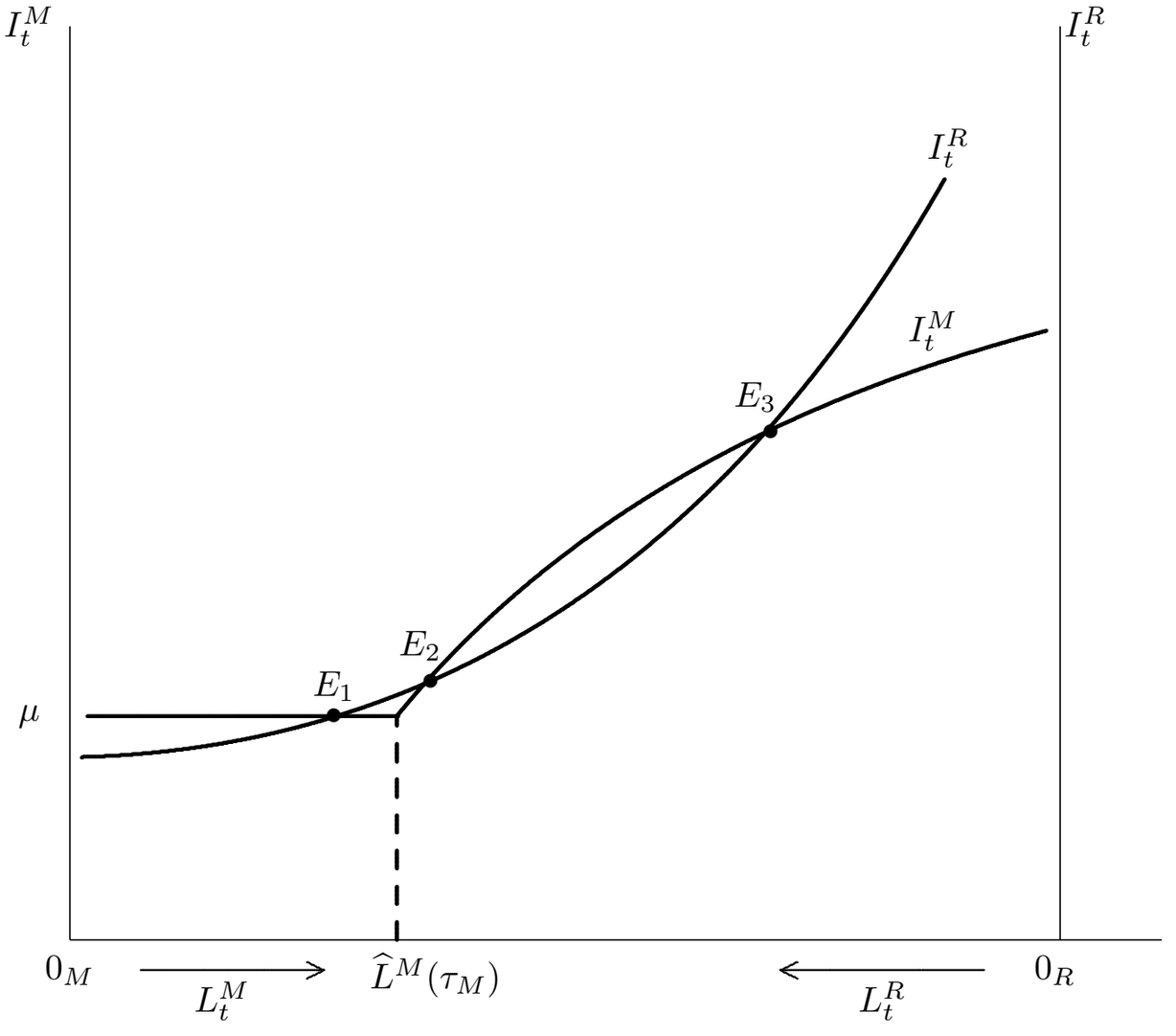

Figure 1

Agriculture Sector

- L_t^R divided between agriculture L_t^A and resources L_t^N
- Production function in agriculture: $A_t = L_t^A = L_t^R - L_t^N$
  so, $w_t^A = P_t^A$, the price of A
- Utility for $j = M, R$: $u_t^j = X_t^j + v\left(A_t^j\right)$, with
  $v'(\cdot) > 0 > v''(\cdot)$
- Budget constraint of consumers: $X_t^j + P_t^A A_t^j = I_t^j$
  where I_t^j = disposal income, $j = M, R$
- Utility maximization yields equal per capita consumption of agriculture goods in each region satisfying $P_t^A = v'(A_t^*)$
  so, $w_t^A = v'(A_t^*) = v'(L_t^R - L_t^N)$, decreasing in L_t^R
- By quasilinearity, L^A fixed, so adjustment occurs via L_t^N, L_t^M

Natural Resource Sector

Extraction uses labour and manufacturing goods as inputs

- Fixed amount of labour per unit of extraction Z_t: $L_t^N = Z_t$
- Use of manufacturing goods: $X_t^N = \phi(S_t)Z_t \equiv C(S_t, Z_t)$
- S_t: remaining stock of natural resources at time t
- $\phi'(S_t) < 0$: cost of extraction increases as the stock is depleted, and $\dot{S}_t = -Z_t$

Perfect mobility between sectors in region R: $w_t^N = w_t^A$

Total rent from resource extraction:

$$\Pi_t = P_t^N Z_t - w_t^R Z_t - \phi(S_t)Z_t$$

where price of resource P_t^N increases at a constant rate

The Equilibrium Under Decentralization

Regional governments take as given allocation of labour across regions for simplicity

Infrastructure Investment in Region M

- Choose policies to maximize total after-tax income
- Problem of region M government (if technology modern):

$$\max_{\tau_M} \quad (1-\tau_M) w_t^M L_t^M = (1-\tau_M) D^{\frac{1}{1-\alpha}} \tau_M^{\frac{\alpha}{1-\alpha}} \left(L_t^M\right)^{\frac{1}{\sigma(1-\alpha)}}$$

- Solution: $\tau_M^* = \alpha$
- Optimal tax rate is independent of the allocation of labour
- Using government budget constraint, we have $G_t^* = \alpha X_t$

Natural Resource Extraction in Region R

- Assume that government of region R takes as given the price path of natural resources
- Sets extraction to maximize total discounted regional income $\int e^{-\rho t} Y_t^R$, subject to $\dot{S}_t = -Z_t$, where:

$$Y_t^R = w_t^R L_t^R + \Pi_t = P_t^N Z_t - \phi(S_t) Z_t + v'(L_t^R - Z_t)(L_T^R - Z_t)$$

- From FOCs, obtain version of Hotelling's Rule:

$$\frac{\dot{Y}_{tz}^R}{Y_{tz}^R} = \rho + \frac{C_s(S_t, Z_t)}{Y_z^{R,T}}$$

$\Longrightarrow$ Rate of change in benefits to region R equals rate of time preference plus effect of deletion on cost of extraction

Natural Resource Extraction in Region R, continued

- Assume proportion θ of the rent is shared equally among labour located in region R
- Remaining proportion $1-\theta$ accrues to resource producers
- Per capita income of the residents of region R:

$$I_t^R = w_t^R + \theta \frac{\Pi_t}{L_t^R} = (1-\theta)v'(L_t^R - Z_t) + \frac{\theta}{L_t^R} Y^R(P_t^N, S_t)$$

  which implies:

- $\partial I_t^R / \partial L_t^M > 0$ and $\partial^2 I_t^R / \partial \left(L_t^M\right)^2 > 0$
- so I_t^R is increasing and convex in L_t^M

SEE FIGURE 1

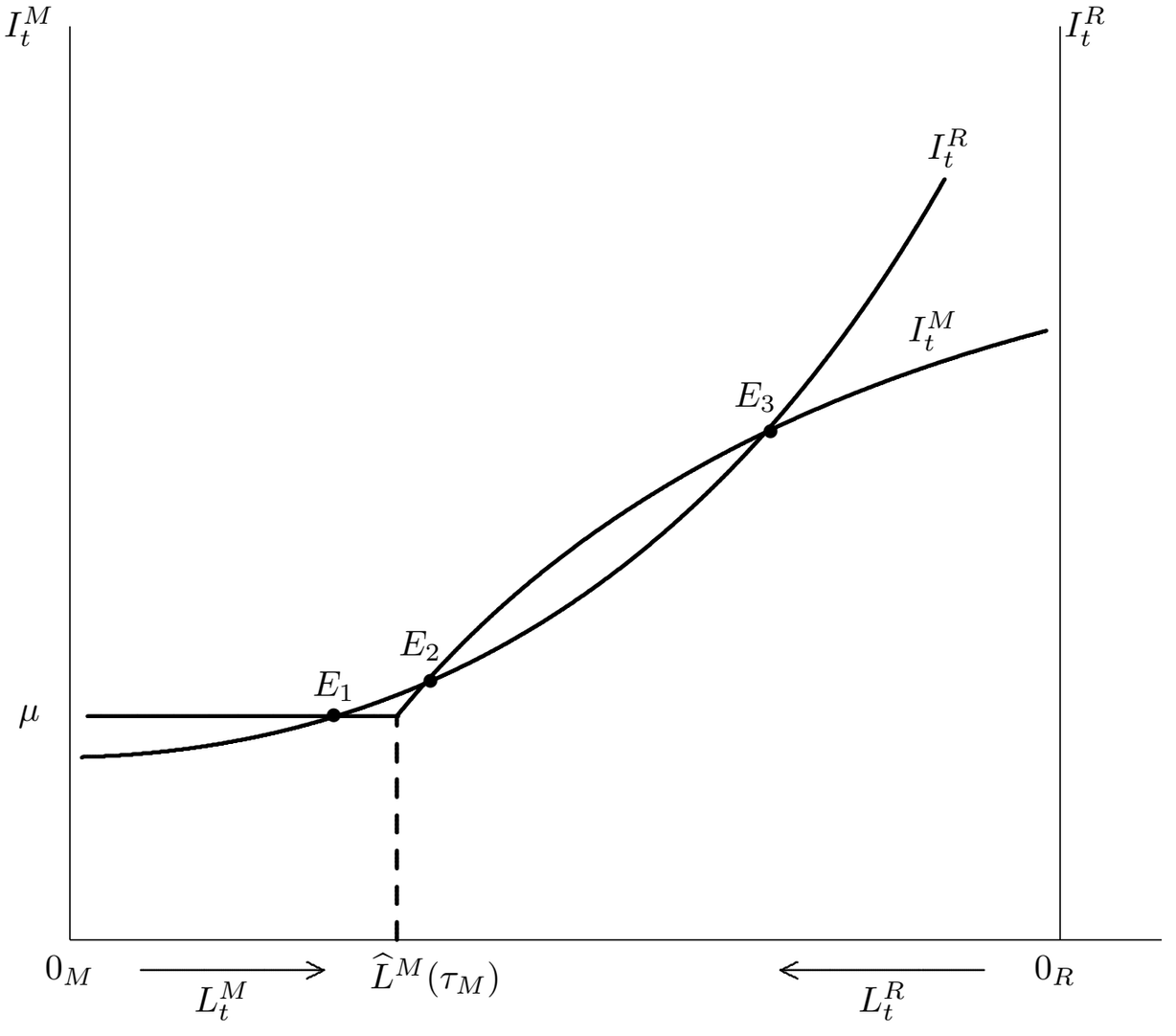

Figure 1

Interregional Labour Allocation

- Migration will gradually equalize per capita disposable income across regions
- For any given resource stock S_t, there can be multiple equilibrium allocations of labour (Figure 1)
- Two stable equilibria:
  - High-income with modern manufacturing (E_3)
  - Low-income with traditional manufacturing (E_1)
- One unstable equilibrium (E_2)
- In the efficient equilibrium E_3, higher productivity resulting from increasing returns-to-scale in manufacturing leads to higher per capita income in both regions

Transitional Dynamics

- Imperfect mobility: Migration requires time so disposable income not equalized instantaneously
- Flow of migration towards region M equal to:

$$\dot{L}_t^M = \eta \left(I_t^M - I_t^R \right)$$

- Transitional dynamics characterized by:

$$\dot{L}_t^M = \eta \left[\mu - I_t^R(1 - L_t^M, S_t, P_t^N, \theta) \right]$$

$$\equiv \Omega_0(L_t^M, S_t, P_t^N, \theta) \quad \text{if} \quad L_t^M < \hat{L}_M$$

$$\dot{L}_t^M = \eta \left[(1 - \tau_M) w_t^M(\tau_M, L_t^M) - I_t^R(1 - L_t^M, S_t, P_t^N, \theta) \right]$$

$$\equiv \Omega_1(\tau_M, L_t^M, S_t, P_t^N) \quad \text{if} \quad L_t^M \geqslant \hat{L}_M$$

$\Omega_1(\cdot) = \dot{L}_t^M$ concave in $L_t^M \quad \Longrightarrow \quad$ **FIGURE 2**

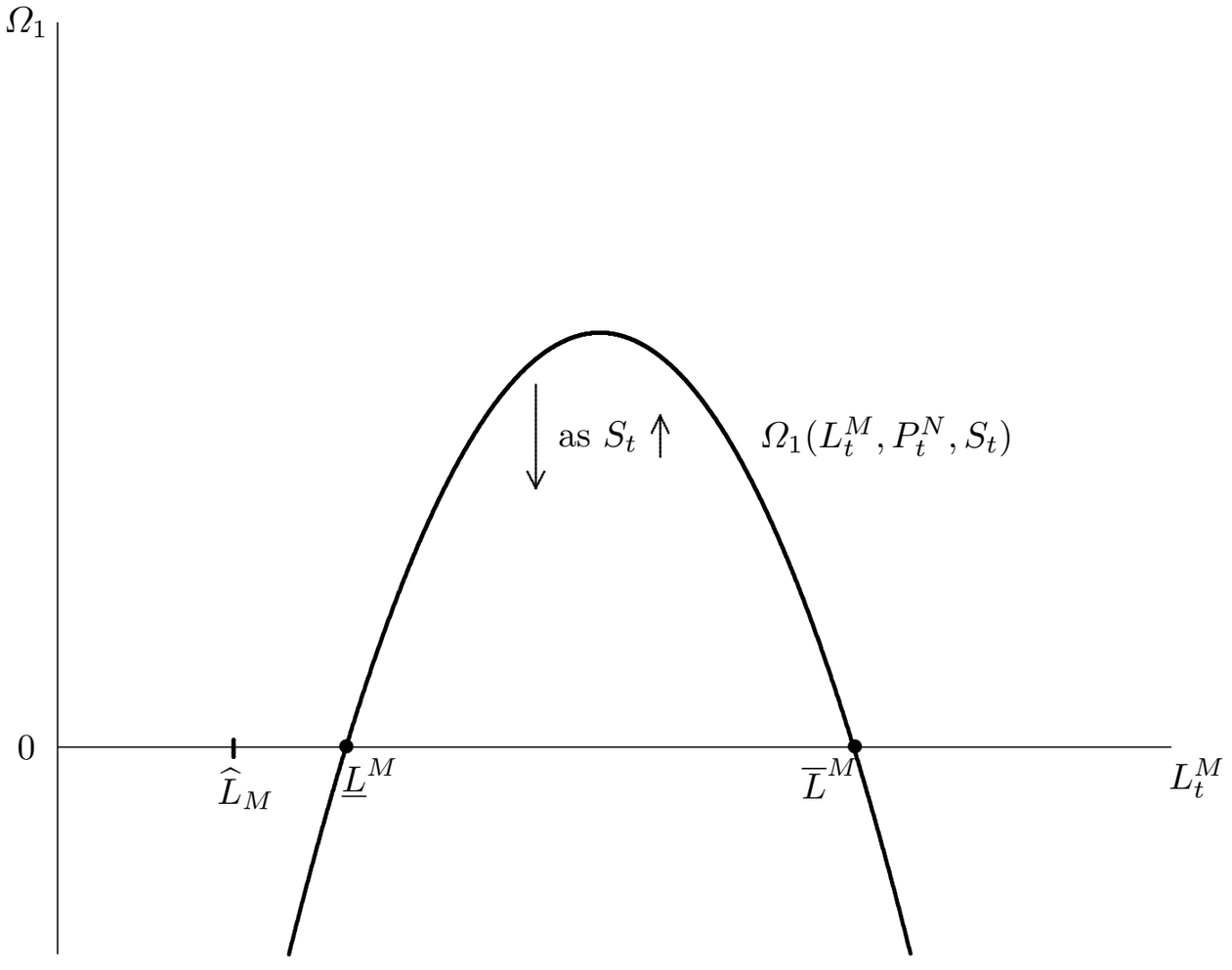
Ω_1
as $S_t \uparrow$
$\Omega_1(L_t^M, P_t^N, S_t)$
0
$\widehat{L}_M$
$\underline{L}^M$
$\overline{L}^M$
L_t^M

Figure 2

Transitional Dynamics, continued

- Economy more likely to converge to low-income equilibrium if S_t and initial L_t^R are relatively high:
  FIGURE 3
- Increase in P_t^N at any point in time will:
  - Increase extraction rate and rent captured by region R
  - Increase migration flow towards region R
  - Shrinks set of initial conditions over (L_t^M, S_t) under which the economy converges to efficient equilibrium
  - Increases total income in the federation in the short-run but may decrease it in the long-run
- An increase in θ:
  - Increases incentive to migrate towards region R
  - No effect on the extraction rate set by regional government
  - Convergence to low-income equilibrium more likely

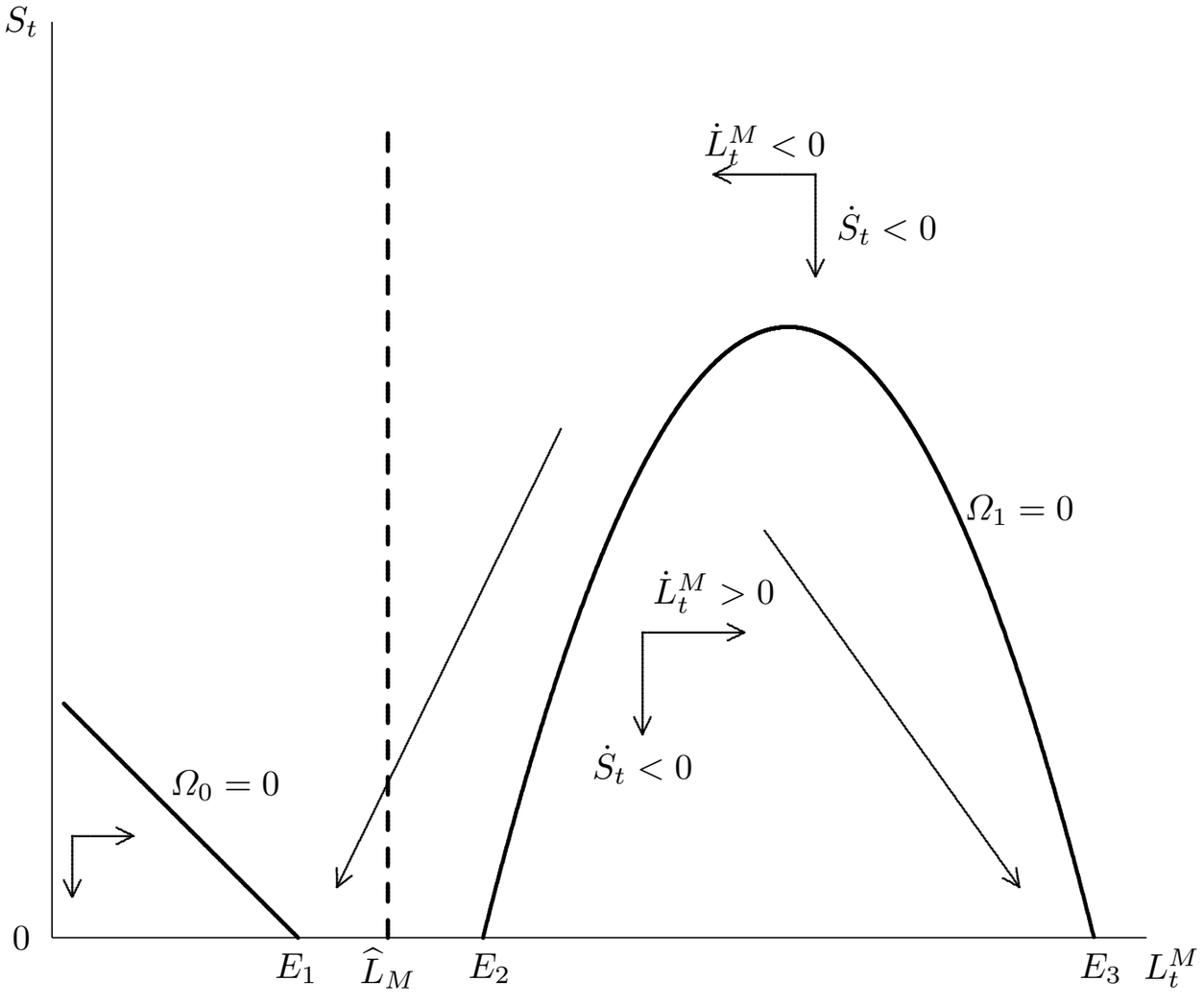
S_t
$\dot{L}_t^M < 0$
$\dot{S}_t < 0$
$\Omega_1 = 0$
$\dot{L}_t^M > 0$
$\dot{S}_t < 0$
$\Omega_0 = 0$
0
E_1
$\widehat{L}_M$
E_2
E_3
L_t^M

Figure 3

The Constrained Federal Optimum

Tax rate τ_M and resource extraction Z_t in each period that maximize discounted flow of aggregate income, or

$$\max_{\{\tau_M, Z_t\}} \int e^{-\rho t} \left(Y_t^M + Y_t^R \right) dt$$

subject to $\dot{S}_t = -Z_t$, where

$$Y_t^M = (1 - \tau_M) w_t^M (L_t^M, \tau_M) L_t^M$$

$$Y_t^R = P_t^N Z_t - \phi(S_t) Z_t + P_t^A A_t$$

Solution is constrained optimal in the sense that labour migration inefficiency is not corrected

Characterization of Constrained Federal Optimum

Optimal tax rate in manufacturing

- $\tau_M = \alpha$: Same as in decentralized case

Optimal extraction satisfies

$$\frac{\dot{Y}_{tz}}{Y_{tz}} = \rho + \frac{C_S(S_t, Z_t)}{Y_z^t}$$

where $Y_{tz} = Y_{tz}^M + Y_{tz}^R$

- Similar to Hotelling's rule in decentralized case, but net marginal benefit of extracting takes into account reduction in manufacturing production in region M that results from reallocating labour to region R when extraction increases

Characterization of Constrained Federal Optimum, continued

Features of the Constrained Federal Optimum

- Over-extraction of the regions is corrected
- More likely to converge to high-income equilibrium E_3, but not guaranteed without further policies
- Even in equilibrium E_3, there will be migration inefficiency
- Too little labour located in region M because of:
  - agglomeration externalities in manufacturing sector
  - rent-seeking migration to obtain share θ of resource rents
- Migration inefficiency could in principle be corrected by equalization
- Equalize for both resource rents and agglomeration externalities, which is challenging

Extensions

Examine central government intervention to induce socially optimal extraction

- Various instruments: rent tax, system of equalization transfers across regions, federal infrastructure program

Examine incentives of resource region to use resource rents to invest in infrastructure to develop manufacturing sector

- Diversification of resource region
- Dilution of economies of scale in the manufacturing region

Turn to Canadian Case as Example $\Longrightarrow$

The Canadian Case

- A very decentralized federation, rich in exported natural resources with volatile international prices
- Horizontal & vertical balance addressed by gross equalization and equal per capital social transfers
- Provinces own natural resources within their boundaries, and offshore in the case of NL and NS
- Natural resources unequally distributed, partially equalized: Horizontal imbalance remains
- Growth of investment & employment in resource-rich provinces; decline elsewhere
- Resource-rich provinces do not save resource revenues: Use them for province-building
- Temporary Foreign Worker program used to relieve labour shortages in resource-rich provinces
- Infrastructure issues getting natural resources to market

Evidence of Effect of Resource Boom in Canada

Beine, Bos & Coulombe (2012) two-stage analysis for 2002-08

1. Effect of external shocks on real exchange rate
   - Canadian component (resource exports): 42% of total
   - US component (demand and capital movements): 58% of total
2. Effect of real exchange rate on manufacturing job losses
   - 100,000 (31%) due to Cdn component (Resource curse)
   - 180,000 (55%) due to US component: case for diversification
   - 46,000 (14%) due to long-run structural decline (e.g., China)
   - Improvements in terms of trade account for 30% of living standards: case for saving windfall

Shakeri, Gray and Leonard (2012)

- Found 11 of 18 industries declined in output due to exchange rate depreciation
- Did not distinguish Cdn and US components

Evidence of Effect of Resource Boom, cont'd

Raveh (2012)

- Resources negatively correlated with growth across countries
- Correlation reversed among regions within countries
- Internal migration of labour to resource-rich regions

Beine, Coulombe & Vermeulen (2012)

- Migration of temporary foreign workers mitigates curse
- Permanent migrants ineffective
- Spreading of resource curse to non-resource provinces by inter-provincial migration
- Internal migration reduced by temporary, not permanent, immigration

Gordon (2013)

- Job losses in lower paying manufacturing
- Most high-earning job gains in non-manufacturing

Consequences of Provincial Priority in Resource Taxation

Substantial horizontal imbalance

- Before-equalization fiscal capacities (2011–12): 67% – 93% in recipients; 133% – 166% in resource-rich
- After-equalization fiscal capacities (2011-12) 95% of national average in recipient provinces, others unaffected
- Dispute about how much of resource revenues to equalize cost disproportionately borne by Ontario

Do provinces claim reasonable share of resource rents?

- Total public share of rents in Alta is 44% for conventional oil, 47% for oil sands, 58% for natural gas; Alberta Royalty Review Panel recommended increase to 49%, 64%, 63%
- Reasons: perceived competition for investment, higher rate of return required due to political uncertainty, distortionary taxes

Consequences of Provincial Resource Taxation, cont'd

- Provinces do not save resource revenues; spending effect ↑
  - Value of Alberta Heritage Fund (2012) was $16bn (1.4 x annual resource revenues), compared with $660bn in Norway
  - Resource revenues used to reduce current taxes and increase spending; not shared with future generations
- Lack of saving reflects temptation for provincial-building: skews regional development patterns and compounds inefficiencies of fiscally induced migration
- Arguably, provinces have an incentive to develop resources too rapidly: Equalization insures downside risks only
- Policies to encourage processing of natural resources magnifies resource curse
- Limited coordination of transportation infrastructure
- Pressures for temporary foreign workers

Provincial Policy Challenges

- Efficient resource taxation that collects a fair share: cash-flow equivalent regimes (RRT, ACE, competitive leases)
- Efficiency requires
  - Ex ante commitment to tax regime regardless of future prices
  - Symmetric treatment of losses and gains
  - Coordination of rent taxation from initial exploration until final production and closure
  - Ability to enforce taxes, given informational disadvantages
- Resource revenues should be well-managed: to take account of rights of future generations and to mitigate resource curse, creation of SWF invested in foreign assets & drawn on slowly
- Problem arises if revenues used in province of origin: some investment in capital projects with high return (infrastructure, human capital) generally desirable, but a problem if restricted to province of resource origin

Federal Policies: Framework

- Provinces have jurisdiction over resource development and right to levy resource-specific taxes
- Federal government has national efficiency and equity obligations, some explicitly set out in Section 36(1)&(2), others recognized to be in national interest
- Federal government has always collected share of resource revenues through general taxation (25–30%), but
- Share of resource revenues that should go to federal government is an open question
- Federal government cannot directly control pace of resource development, but can address consequences

Federal Policies: Most Pressing Concerns

Horizontal Fiscal Imbalance: Fiscal Equity

- Response to horizontal imbalance involves equalization and social transfers (Sec 36(1),(2) commitments)
- Made difficult by decentralized taxation and lack of access to resource revenues

Treatment of Gainers and Losers: Interpersonal Equity

- Effective tax-transfer and social insurance systems
- Division of income tax room important

Provincial Spending of Resource Revenues

- Problem of failure to save resource revenues
- Compounded by use of resource revenues for province-building

Limitations on Federal Adjustment Mechanisms

- Tax policy limits federal government capture of resource rents
  - Favourable corporate tax treatment of resource industries
  - Deductibility of royalties and mining taxes
  - Low federal corporate tax rate
- Limited equalization of natural resource (50%)
  - No equalization of resource-rich provinces
  - Perverse treatment of Ontario vs Newfoundland
- Social transfers implicitly equalizing, but not for resources
- Decentralized tax-transfer system limits adjustment to resource shocks
- Vertical fiscal balance issues
  - Rising provincial relative to federal debt (PBO) increases interprovincial fiscal competition pressures
- Overall, stabilization mechanisms of federalism compromised: fed-prov transfers, tax-transfer system, efficient migration

Federal Policies: Options Limited

Some observers' suggestions

- Maintain and enhance integrity of equalization, including removal of GDP growth cap
- Improve equalization component of social transfers by conditioning them on fiscal capacity
- Improve progressivity of tax-transfer system
- Reform corporate tax to make it efficient (e.g., ACE) and enhance federal share of resource revenues
- Counter-balancing negative impact of province-building policies is harder, & maybe not feasible
  - Federal government investment in infrastructure for the traded goods sectors to improve productivity?
  - Federal investment in human capital elsewhere in Canada?
  - Add element of infrastructure needs to equalization?
  - Federal sovereign wealth fund?