Non-tradable Goods, Factor Markets Frictions, and International Capital Flows

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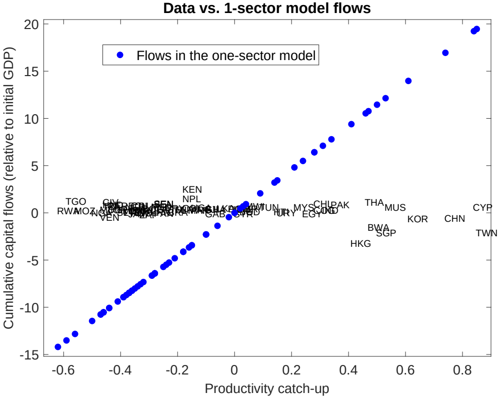
International capital flows - data vs. theory

1. Feldstein-Horioka puzzle
   - $corr(S, I) > 0$ in the data
2. Lucas puzzle
   - K has not flown to poor countries, despite $\left(\frac{K}{Y}\right)^{\text{poor}} < \left(\frac{K}{Y}\right)^{\text{rich}}$
3. Allocation Puzzle
   - $corr\,(\Delta TFP, \Delta \text{external debt}) < 0$
4. **Quantity Puzzle** (not as famous as the other three)
   - Neo-classical **1-sector model over-predicts** international capital flows **by a factor of 10**
   - Gourinchas and Jeanne (REStud, 2013); Rothert (EL, 2016)

Quantity Puzzle



Data flows: Gourinchas and Jeanne (2013), replicated

X-axis: $\dfrac{TFP_{2000}/TFP_{1980}}{TFP^{USA}_{2000}/TFP^{USA}_{1980}} - 1$

Y-axis: $\dfrac{-\sum_{t=1980}^{2000} CA_t}{GDP_{1980}}$

International capital flows are important

Numerous gains from international mobility of capital

- risk sharing
- allocation of resources to most productive uses
- inter-temporal optimization

Net flows in the model $>>$ **Net flows in the data**

Different reasons will have **different policy implications**

- **fundamentals** vs. market imperfections
- **domestic frictions** vs. international frictions

This paper

Non-traded sector

- fundamental feature missing in the one-sector growth model
- large part of both consumption and investment expenditures

Domestic frictions to inter-sectoral reallocation of K and L

- structural change in growing economies takes place gradually

No frictions in international financial markets

Results

In the model with non-traded sector and domestic frictions:

- net flows $\downarrow$ by about 50%, and
- mean squared error model vs. data $\downarrow$ by over 60%,

relative to the one-sector model.

No claim that international frictions do not exist or are not important. They certainly are.

But so are fundamentals and domestic frictions.

Literature

1. Capital flows in an open economy with non-traded sector
    - Theory: Murphy (1986), Engel and Kletzer (1989), Brock and Turnovsky (1994)
    - Our paper is quantitative

2. Puzzles in capital flows - fundamentals vs. frictions
    - Feldstein and Horioka (1980), Lucas (1990), Gourinchas and Jeanne (2013)
    - Baxter and Crucini (1993), Causa et al. (2006)
    - Reinhart and Rogoff (2004), Portes and Rey (2005), Alfaro et al. (2008), Bai and Zhang (2010), Song et al. (2011), Mendoza et al. (2009), Buera and Shin (2009), Michaud and Rothert (2014)
    - Our paper is (mostly) about fundamentals - non-traded sector

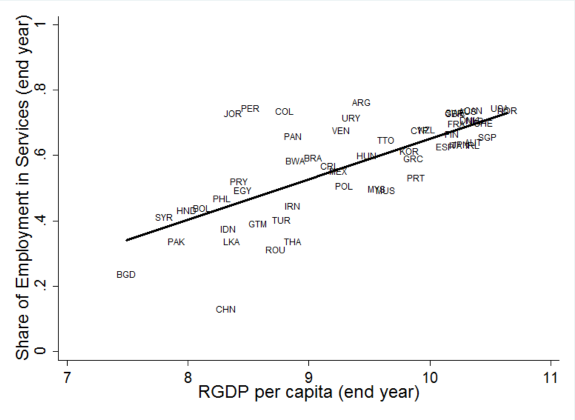
Literature

3. Domestic vs. international frictions
   - Ohanian et al. (2018), Caselli (2007)
   - We emphasize the role of **domestic frictions**

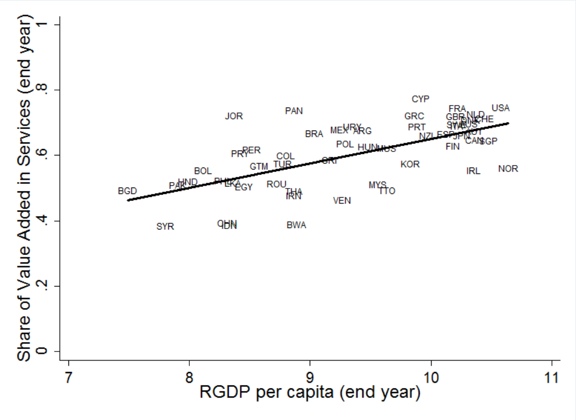
4. Robustness of the Allocation Puzzle
   - Aguiar and Amador (2011), Reinhardt (2010), Rothert (2016)
   - We focus on the most robust result — (almost perfect) negative correlation between productivity catch-up and the savings wedge

M O T I V A T I O N

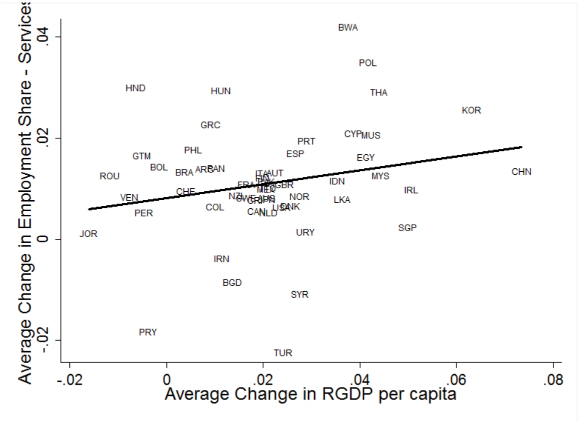
Variation in the size of the service sector



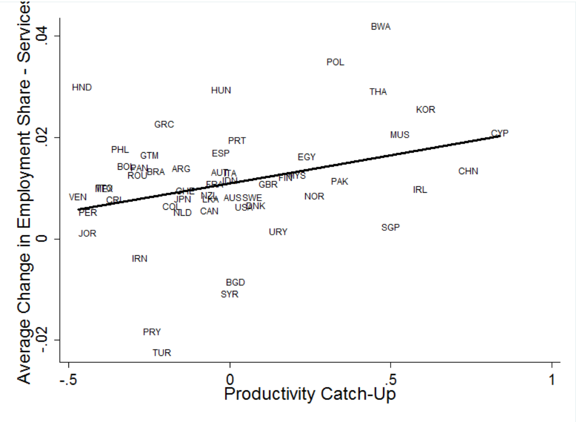
Variation in the size of the service sector



Gradual structural change - vs. GDP growth



Gradual structural change - vs. TFP catch-up

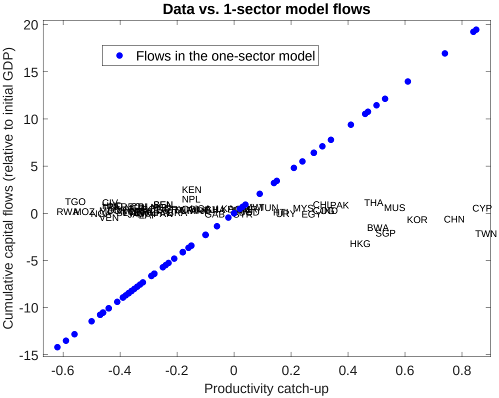


Fast-growers: low ℓ^N initially, gradually increasing

	avg growth	$\ell^N_{2000}/\ell^N_{1980} - 1$
Bottom 20	-0.004	0.010
Top 20	0.049	0.019
$\rho(\Delta\ell^N, g)$	0.292	

Once we incorporate that in the model, what is the impact on capital flows?

Can we reduce the slope of the blue line?



Non-traded sector and capital flows - intuition

1. Savings margin
   - fast-growing countries started poor, with low output of non-tradeables
   - T and N are complements - low output of N early on, means MU of T-goods is low
2. Investment margin
   - fast-growing countries undergo structural change: % of labor force employed in services rises
   - slows down MPK growth in the traded sector
3. Reallocation frictions
   - no massive movement of labor from T to N

M O D E L

Model overview

Small open economy — world interest rate fixed at R^*

- no frictions in international financial markets

Two sectors producing (T)raded and (N)on-traded goods

Both goods are **used for consumption and investment**

- different CES aggregators for cons. and inv.

Both goods **require capital and labor** to be produced

- decreasing returns to scale — avoids corner solutions

Limited mobility of capital and labor **between sectors**

- putty-clay (K, once installed, only depreciates)
- force the model to match observed labor flows exactly

Sector specific total factor productivities (TFPs)

Production and investment

Production = Expenditure

$$
\begin{aligned}
Y_t^T &= \left(A_t^T\right)^{1-\alpha^T} \cdot \left(K_{t-1}^T\right)^{\alpha^T} \left(\ell_t^T\right)^{0.95-\alpha^T} = C_t^T + X_t^T + NX_t \\
Y_t^N &= \left(A_t^N\right)^{1-\alpha^N} \cdot \left(K_{t-1}^N\right)^{\alpha^N} \left(\ell_t^N\right)^{0.95-\alpha^N} = C_t^N + X_t^N
\end{aligned}
$$

Law of motion for capital stocks (putty-clay)

$$
K_t^s \leq (1-\delta)K_{t-1}^s + I_t^s; \qquad I_t^s \geq 0; \qquad s = T, N;
$$

Investment — Cobb-Douglas aggregator — Bems (RED, 2008)

$$
I_t^T + I_t^N \leq X_t = H\left(X_t^N, X_t^T\right) = \left(X_t^N\right)^{\omega_X} \cdot \left(X_t^T\right)^{1-\omega_X}
$$

Consumption

$$C_t = G\left(C_t^N, C_t^T\right) = \left[\omega_C \cdot \left(C_t^N\right)^{\frac{\eta-1}{\eta}} + (1-\omega_C) \cdot \left(C_t^T\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$$

η = elasticity of substitution

Literature: $\eta < 1$

Utility maximization

$$\max \sum_t \beta^t \frac{C_t^{1-\sigma} - 1}{1-\sigma}$$

subject to:

$$\begin{aligned}
C_t &\leq G\left(C_t^N, C_t^T\right) \\
C_t^T + X_t^T + p_t^N\left(C_t^N + X_t^N\right) &= \left(w_t^T \ell_t^T + w_t^N \ell_t^N\right) N_t \\
&+ r_t^T K_{t-1}^T + r_t^N K_{t-1}^N \\
&+ D_t - R^* D_{t-1} + \text{Tax/Transfer}_t \\
K_t^s &\leq K_{t-1}^s + I_t^s, \quad s = T, N \\
I_t^T + I_t^N &\leq H\left(X_t^N, X_t^T\right) \\
\ell_t^T + \ell_t^N &\leq 1
\end{aligned}$$

Matching empirical allocation of labor across sectors

Introduce a time-varying "labor allocation wedge" into the model

Acts like a tax / subsidy on employment in the non-traded sector

$$\frac{\partial Y_t^T}{\partial \ell_t^T} = w_t^T = w_t^N = (1 - \tau_{\ell,t}) \cdot p_t^N \frac{\partial Y_t^N}{\partial \ell_t^N}$$

where $(1 - \tau_{\ell,t})$ is the labor allocation wedge.

The amount $\tau_{\ell,t} w_t^N \ell_t^N$ = lump-sum tax paid by HHs
(transfer if $\tau_{\ell,t} < 0$)

Recover $(1 - \tau_{\ell,t})$ such that $\ell_t^N(\text{model}) = \ell_t^N(\text{data})$

Parameter values

Parameter description	Value	Source
Elast. of subst. - inter-temporal	$\sigma = 1.00$	GJ
Discount factor	$\beta = 0.96$	GJ
Growth rate of the TFP frontier	$g^* = 1.75\%$	GJ
Elast. of subst. - T vs. N in Cons.	$\eta = 0.10$	HRV
N share in consumption	$\omega_C = 0.80$	VPG
N share in investment	$\omega_X = 0.60$	BEMS
Capital Share - T-sector	$\alpha^T = 0.37$	HV
Capital Share - N-sector	$\alpha^N = 0.32$	HV
Capital depreciation	$\delta = 0.06$	GJ

VPG: Villacorta et al. (2015); BEMS: Bems (RED, 2008)

GJ: Gourinchas and Jeanne (REStud, 2013)

HV: Herrendorf & Valentinyi (RED, 2008)

HRV: Herrendorf et al. (AER, 2013)

Steady-State and Transition Path

At $t = 1$ each economy is in its initial steady-state:

- calibrate country-specific $\left(D_0, a_0^N \equiv \frac{A_0^N}{A_0^T}, \tau_{\ell,0}\right)$ to match
- initial level of: debt/GDP, services/GDP, labor in services

Between $t = 1$ and $t = T$, in each country i:

- sectoral TFPs grow at rates $g^T(i)$ and $g^N(i)$
- labor allocation wedge $\tau_{\ell,t}(i)$ changes so that:

$$\frac{\ell_T^N(i) - \ell_0^N(i)}{T} = \frac{\ell_T^{\text{serv}}(i;\text{data}) - \ell_0^{\text{serv}}(i;\text{data})}{T}$$

For $t > T$:

- $g^T(i) = g^N(i) = g^*$ — balanced growth path
- labor allocation wedge $\tau_{\ell,t}(i)$ changes so that $\ell_t^N(i) = \ell_T^N(i)$

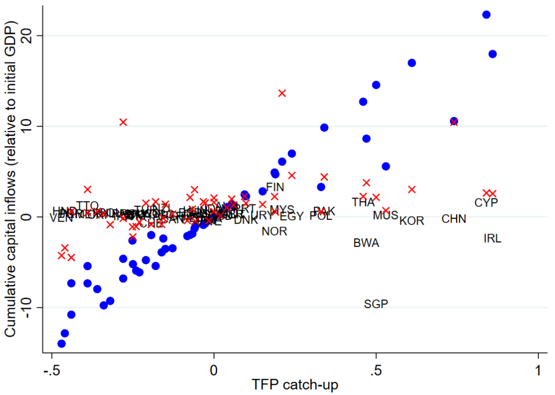
Calibration of TFPs and labor alloc. wedge

For each country:

- Impose exogenous path of $\left(\ell_t^N\right)$ to match $\frac{\ell_T^{\text{serv}}(\text{data})-\ell_0^{\text{serv}}(\text{data})}{T}$
  - assume linear reallocation of labor
- calibrate g^T and g^N to match
  - average annual growth of real GDP per capita
  - average annual appreciation of the real exchange rate
- recover the sequence of labor allocation wedge $(\tau_{\ell,t})$ from:

$$MPL_t^N \cdot p_t^N \cdot (1-\tau_{\ell,t}) = MPL_t^T$$

Results: size of net capital flows



1-sector model vs. 2-sector model with domestic frictions

Table: Capital Flows - Data vs. Model Series

	Capital Flows			
Data	min $\frac{\Delta D}{Y_0}$	max $\frac{\Delta D}{Y_0}$	$\rho\left(\frac{\Delta D}{Y_0}, \pi\right)$	$\frac{\sum_n (err_n)^2}{N}$
Total	-9.60	3.31	-0.28	-
Public	-2.25	0.45	-0.38	-
Private	**-0.59**	**1.81**	**0.09**	-
Model				
one-sector	**-13.99**	**22.32**	**0.96**	**67.12**
two-sector benchmark	**-4.47**	**13.66**	**0.48**	**14.33**
counterfactual with ℓ mobile	-6.92	31.95	0.54	63.19
re-calibrated with K mobile	-4.62	12.74	0.64	15.68
counterfactual with K & ℓ mobile	-6.95	36.32	0.61	80.29

Matching the flows exactly - wedges

Current account $\equiv$ Savings minus Investment

How important are the savings and investment margins?

Budget constraint in a 1-sector small open economy with wedges:

$$C_t + K_{t+1} = (1 - \tau_s)(R_t(1 - \tau_k)K_t - R^* D_t) + D_{t+1} + \text{other} \ldots$$

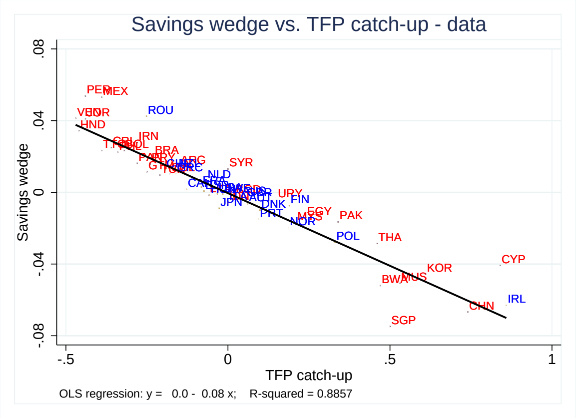
τ_k — difference between domestic and foreign return to capital

τ_s — difference between $MRS_{C_t, C_{t+1}}$ and R^* (world int. rate)

Result (Gourinchas and Jeanne, 2013) — **savings wedge is key**!

Calibrated savings wedge vs. TFP catch-up

"the allocation puzzle is a savings puzzle" — GJ



Can the non-traded sector account for the graph above?

Results: model- vs. data-based savings wedge

"the quantity puzzle is a savings puzzle" — JRJS

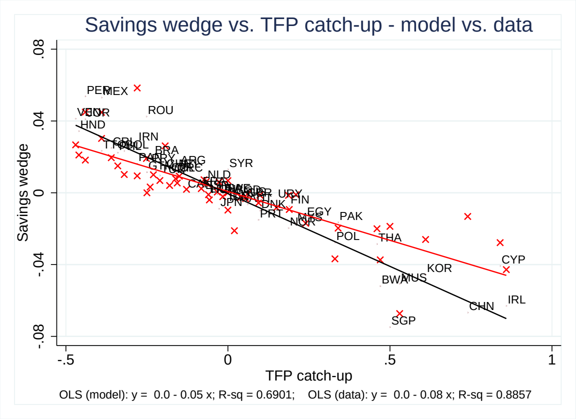


Table: Savings Wedge - Data vs. Model Series

	Savings wedge implied by the flows			
	min τ_S	max τ_S	$\rho(\tau_S, \pi)$	$\rho\left(\tau_S, \tau_S^{GJ}\right)$
Data				
Total	-0.075	0.054	-0.94	1.00
Public	-0.067	0.051	-0.97	1.00
Private	**-0.066**	**0.055**	**-0.96**	1.00
Model				
one-sector	0	0	0	0
two-sector benchmark	**-0.072**	**0.073**	**-0.820**	**0.83**
counterfactual with ℓ mobile	-0.071	0.089	-0.694	0.73
re-calibrated with K mobile	-0.067	0.058	-0.831	0.85
counterfactual with K & ℓ mobile	-0.075	0.079	-0.693	0.72

Conclusions

- Non-traded sector combined with reallocation frictions can account for more than 60% of discrepancy between observed capital flows and those implied by the 1-sector growth model.
- Domestic frictions can be an important factor affecting international capital flows.