# Why Does Capital Flow to Rich States? *

Sebnem Kalemli-Ozcan

University of Houston and NBER

Ariell Reshef

University of Virginia

Bent E. Sørensen

University of Houston and CEPR

Oved Yosha

October 2008

## Abstract

The magnitude, and even the direction, of net international capital flows does not fit neoclassical models well; in particular, rich countries attract net flows that should go to poor, capital scarce countries according to the models. The 50 U.S. states comprise an integrated capital market with very low barriers to capital flows, which makes them an ideal testing ground for neoclassical models. We develop a simple frictionless open economy model with perfectly diversified ownership of capital and find that capital flows between the U.S. states are consistent with the model. Therefore, the small size and "wrong" direction of net international capital flows are likely due to frictions associated with national borders rather than to inherent flaws in the neoclassical model.

Keywords: capital flows, ownership, historical income, net factor income.
JEL Classification: F21, F41

---

# 1   Introduction

International capital flows have surged since the early 1990s, creating renewed interest in
their determinants. One salient fact of this recent increase is the small size of net capital
flows relative to gross flows.[1] In addition, capital has flowed "uphill" from poorer to richer
countries in the last decade, a phenomenon that is manifested in the recent global imbal-
ances.[2] These empirical patterns are at odds with theoretical benchmarks. The goal of this
paper is to demonstrate the viability of the simple neoclassical model in the ideal setting of
fully integrated economies such as the 50 U.S. states. We develop a frictionless open economy
neoclassical model where capital income is fully diversified and show that it fits the data for
U.S. states well, both qualitatively and quantitatively.

The key elements of our model are as follows. Capital income—but not labor income—is
fully diversified between states and total factor productivity (TFP) varies across states and
over time.[3] We assume that capital markets are fully integrated in the sense that individuals
can borrow and lend freely across state borders and insure themselves against state-specific
risk by holding a geographically diversified portfolio of assets. Hence, relative investment is
determined by relative productivity levels and savings do not have any role in determining
relative investment. The model predicts that capital will flow to fast growing states from
slow growing states and as a result high growth states pay capital income to other states.[4]
With persistent productivity shocks, high output—"rich"—states end up being net debtors
more often than not.

---

[1]Obstfeld and Taylor (2005) characterize 1990s as the era of limited "development finance" relative to
"diversification finance."

[2]As shown by Lucas (1990) capital should flow from rich to poor countries as implied by the Solow model,
where capital markets are integrated and the level of total factor productivity is constant across countries
and over time.

[3]The literature provides evidence that labor mobility is not so fast as to instantly equalize wages across
states. Bernard et al. (2005) show that there are significant skilled-wage differences across states which
implies low levels of net migration. Bound and Holzer (2000) find that imperfect mobility of unskilled
workers in the United States contributed toward increased income inequality in the 1980s.

[4]More precisely, capital pays capital income in the form of dividends, interest, and transfers within multi-
state companies. Capital income flows to and from other states provide risk sharing. Our results complement
studies such as Asdrubali, Sørensen, and Yosha (1996): they find that state-level income is about 40 percent
insured against output shocks.

Our model delivers the following predictions: 1) income increases less than output in high growth states, 2) net dividends converge to zero in the absence of growth shocks, and 3) high output states tend to pay net dividends. We simulate the model in order to obtain quantitative predictions and then verify that these results hold using U.S. state-level data. Consequently, we conclude that the main explanation for the small size and "wrong" direction of international capital flows is more likely due to "frictions" associated with national borders—making international financial markets de facto incomplete—rather than to inherent deficiencies in the simple neoclassical model.[5]

Testing the implications of the model in a regression framework requires data on interstate net capital flows. We do not have data on state level current accounts, but income flows ("dividends") between states typically reflect past net investment flows. However, dividend payments between states are not directly observed either. In the country-level national accounts net capital income flows are approximately equal to the difference between Gross National Income ("income") and Gross Domestic Product ("output").[6] Output is observed for U.S. states but the state-level equivalent of GNI is not. We use approximations to state-level GNI based on observed state-level personal income. Thus, the ratio of output to income ("output/income") is an indicator of net capital income. When the ratio is larger than one, this indicates a net capital income outflow. We derive the predictions of the model for the output/income ratio and test these predictions.

The output/income ratio has been used before to infer past net capital flows between U.S. states by Atkeson and Bayoumi (1993a,b) who found large inter-regional net capital flows within the United States. However, they did not systematically match their findings to a model nor did they study the determinants of state level capital flows. Of particular relevance is their finding that personal dividend income is highly correlated across states,

---

[5]Examples of frictions associated with borders are explicit barriers to investment or factors affecting investors ex post returns such as bad institutions (corruption and rule of law), and sovereign risk; see, for example Alfaro, Kalemli-Ozcan, and Volosovych (2008) and Reinhart and Rogoff (2004).

[6]The difference between Gross Domestic Product and Gross National Income is net factor income which includes the net earnings of domestic *residents* abroad (not based on citizenship). However, foreign earnings of domestic residents are usually fairly small compared to capital income.

consistent with our assumption that capital ownership is diversified geographically.[7]

The surge in international asset trade has triggered a recent research effort on the portfolio models of the current account. Starting with the partial equilibrium approach of Kraay and Ventura (2000), this literature highlights the importance of countries' net external positions in the determination of current account balances, and hence the pattern of capital flows. A central result in this literature is that countries hold a constant ratio of domestic to foreign capital, which has been debated recently.[8] We contribute to this debate as our model shows that portfolio shares follow a mean-reverting process, an implication that is supported by the U.S. state-level data.

In the next section, we derive and simulate theoretical predictions. Section 3 performs the empirical analysis. Section 4 concludes the paper.

## 2   Capital Flows in a Neoclassical Growth Model

Consider states $i = 1, ..., N$, with labor force $L_{it}$. Output at time $t$ is given by $GDP_{it} = A_{it} K_{it}^{\alpha} L_{it}^{1-\alpha}$, where $K_{it}$ is capital in state $i$ and $0 < \alpha < 1$. We denote the aggregate capital stock by $K_t$. State $i$'s ownership share is $\phi_{it}$, so that assets *owned* by state $i$ are $\phi_{it} K_t$ with $\Sigma_{i=1}^{N} \phi_{it} = 1$, where the last equality follows from the assumption that the United States is a closed economy.[9] We can, therefore, also think of $K_t$ as the value of a U.S.-wide mutual fund.

Under market integration the ex ante gross rate of return to investment is $R_t$ for all states—in our simulations, $R_t$ will be the equilibrium market clearing rate of interest. We

---

[7]At the country level capital flows are usually directly observed, but Bertocchi and Canova (2002) use the output/income ratio to infer past net inflows of capital to former African colonies where the historical capital flows data of interest are not observed.

[8]According to Kraay and Ventura (2000) capital flows are caused by portfolio growth through changes in wealth, where countries invest the marginal unit of wealth as the average unit. In other words, portfolio shares are constant. On the other hand, more recent papers, such as Devereux and Sutherland (2006) and Tille and van Wincoop (2008), focus on general equilibrium effects and show that international capital flows can be broken down into a portfolio growth component that is associated with savings and a portfolio reallocation component associated with changes in expected risk and returns.

[9]The assumption that the United States is a closed economy is not likely to affect our empirical results since our regressions control for aggregate U.S.-wide effects.

assume that capital ownership is fully diversified and risk premiums are negligible. Therefore, capital will flow to state $i$ until the marginal return to capital equals the U.S.-wide gross interest rate $R_t$; i.e., $R_t = \alpha A_{it} K_{it}^{\alpha-1} L_{it}^{1-\alpha}$, $\forall i, t$, which implies $K_{it} = L_{it}(\frac{\alpha A_{it}}{R_t})^{\frac{1}{1-\alpha}}$. The gross income of the U.S.-wide mutual fund is $R_t K_t$ and the wage rate in state $i$ is $w_{it} = (1-\alpha)A_{it}K_{it}^{\alpha}L_{it}^{-\alpha}$. Gross (pre-depreciation) income, GNI in state $i$ is, therefore, $GNI_{it} = \phi_{it} R_t K_t + w_{it} L_{it} = \phi_{it} R_t K_t + (1-\alpha)A_{it}K_{it}^{\alpha}L_{it}^{1-\alpha}$ and the output/income (GDP/GNI) ratio is

$$\frac{GDP_{it}}{GNI_{it}} = \frac{A_{it}K_{it}^{\alpha}L_{it}^{1-\alpha}}{\phi_{it} R_t K_t + (1-\alpha)A_{it}K_{it}^{\alpha}L_{it}^{1-\alpha}} = \frac{GDP_{it}}{\phi_{it} R_t K_t + (1-\alpha)GDP_{it}} \ . \tag{1}$$

The output/income ratio measures the relative magnitude of net inter-state capital income flows from a state. If such flows are zero, the ratio is unity; if they are negative, the ratio is less than unity; and if they are positive, the ratio exceeds unity.

Equation (1) implies that the output/income ratio is a function of output and capital ownership. Another implication of equation (1), under the assumption that growth in state $i$ will not affect $R_t K_t$, is that

$$d(\frac{GDP_{it}}{GNI_{it}}) \approx \alpha \frac{dGDP_{it}}{GDP_{it}}, \tag{2}$$

where the derivative is evaluated at the point $GNI_{it} = GDP_{it}$.


*Dynamics of Ownership*

The law of motion for capital is $K_{t+1} = (1-\delta)K_t + s\,GNI_t$ where $s\,GNI_t$ is gross savings, $s$ is the savings rate, and $\delta$ is the depreciation rate. The stock of capital owned by state $i$ in period $t+1$ is $\phi_{it}K_t(1-\delta) + s\,GNI_{it}$ and the law of motion for the ownership share is

$$\phi_{it+1} = \frac{\phi_{it}K_t(1-\delta) + s\,GNI_{it}}{K_t(1-\delta) + s\,GNI_t} \ . \tag{3}$$

In the absence of productivity shocks, with equal populations and productivity levels, the portfolio shares revert to the mean of $1/N$ and hence the GDP/GNI ratio reverts to 1 over time, assuming that the saving rate is constant across states. The mechanism is given as follows: consider a state with a one-time positive productivity shock. This state will see

4

output increase more than income, but because wages will be higher than in other states, savings will also be higher. The higher savings will result in higher asset income in the following period and the result is gradual convergence of the level of income to the new output level.

*Workers and Stock Holders*

Not all workers hold assets and some asset holders are not workers (in particular, retirees). We can predict the marginal impacts by considering partial derivatives of the output/income ratio with respect to workers (without assets) and "stock holders" (asset holders).

To examine the role of stock-holders and workers consider the symmetric case $GDP_{it} = GDP_t \frac{L_{it}}{L_t}$ and assume that the number of shareholders in state $i$ is $S_{it}$ with $\Sigma S_{it} = S_t$.[10] Consider the point where each shareholder owns $K_t/S_t$ shares and the number of shareholders varies by state. In this case, ownership shares are equal to the share of stock-holders, and we get

$$\frac{GDP_{it}}{GNI_{it}} = \frac{\frac{L_{it}}{L_t}GDP_t}{\frac{S_{it}}{S_t}\alpha GDP_t + (1-\alpha)\frac{L_{it}}{L_t}GDP_t} \ . \tag{4}$$

We can find the predicted change in the output/income ratio at the point $L_t = S_t$, implying an output/income ratio of $\frac{1}{(\alpha \frac{S_{it}}{L_{it}} + (1-\alpha))}$, by taking the differential. We find

$$d(\frac{GDP_{it}}{GNI_{it}}) \approx \alpha \frac{dGDP_{it}}{GDP_{it}} - \alpha \frac{dS_{it}}{L_{it}} + \alpha \frac{dL_{it}}{L_{it}} \ , \tag{5}$$

where the first term is a repetition of equation (2).

## 2.1 Comments on the Model

Our model is a dynamic stochastic general equilibrium model albeit the assumption of constant savings rates renders it particularly simple to solve. Our goal is to demonstrate that a bare-bones neoclassical model fits the U.S. data well. A more complicated model might do an even better job, but we are constrained by the availability of data. In this section, we

---

[10]Each shareholder will own $\phi_{it}K_t/S_{it}$ shares.

discuss three central issues, namely saving, productivity, and capital reallocation.

As an empirical matter, reliable estimates of state-level savings are hard to come by. Therefore we prefer not to condition our predictions on models of saving. According to permanent income theory, individuals save a smaller fraction of their income the higher the expected present value of future income shocks. As argued by Glick and Rogoff (1995), the intertemporal approach to the current account implies that following a permanent country-specific shock, there will be a current account deficit in excess of the corresponding rise in investment.[11] They argue that the response of savings can be justified by productivity shocks that are slowly mean reverting.[12] In our model, because of full diversification and hence no risk premia, relative investment will be determined by relative productivity with no role for state-specific savings rates. Hence, both debtor and creditor countries can attract capital on net and run current account deficits if they are hit by positive persistent productivity shocks. If capital flows to high growth regions we should, everything else equal, see that high output regions run current account deficits and hold negative net asset positions.[13] On the other hand, poorer regions might be in the "catch-up growth" phase, where low output regions grow relatively faster and attract capital from other regions; an example is the U.S. southern states in the 1950s.[14]

We now turn to discuss productivity. TFP shocks are the fundamental driver in our model. In our empirical implementation a strict technology interpretation of $A$ is misleading

---

[11]This is because permanent income rises more than current income as a result of the permanent shock leading to a fall in saving. Hence, given the random walk nature of country-specific shocks for OECD countries, they argue that the finding of larger responses of investments than current accounts constitutes a puzzle.

[12]Random walks are not mean reverting, but time series tests can not separate random walks from, say, mean reverting AR(1) processes with a coefficient to lagged productivity very close to unity.

[13]Kraay and Ventura (2000) develop a model where investment risk is high and diminishing returns are weak. Their model implies that positive productivity shocks lead to deficits in debtor countries and surpluses in creditor countries. In our model, because of full diversification and no risk premia, relative investment will be determined by relative productivity with no role for savings. Hence, both debtor and creditor countries can attract capital on net if they hit by positive productivity shocks. In addition, we assume that productivity shocks are persistent (as shown by Glick and Rogoff (1995)) as opposed to Kraay and Ventura's assumption that they are transitory.

[14]Note that Gourinchas and Jeanne (2007) and Prasad et al. (2007) find exactly the opposite in a developing country context; i.e., they find that capital goes to *less* productive countries and a positive correlation between current account and growth, respectively.

and in the empirical section TFP should be interpreted very broadly.[15] In particular, relative price changes, such as oil price shocks that increase the return to capital in oil-rich states, are an important source of TFP variation, broadly defined, in our data. The crucial condition behind our results is that capital will flow to a region until the marginal return $\alpha A_{it} K_{it}^{\alpha-1} L_{it}^{1-\alpha}$ exceeds $R_t$. For an example, consider a case with *no* technology shocks but where consumers in all states consume the same consumption basket and the relative price of output sold by state $i$ in the U.S.-wide markets is $p_{it}$. In this case, capital will flow to state $i$ until $\alpha p_{it} K_{it}^{\alpha-1} L_{it}^{1-\alpha}$ equals $R_t$.

We do not imagine machines being dismantled and carted to other states; rather, we imagine that net investment is higher in states with high TFP and that this can be modeled as malleable capital when long time intervals are considered. This approach is supported by Blomstrom et al. (1996), who perform Granger causality tests and show that growth induces subsequent capital formation more than capital formation induces subsequent growth at the country level.[16]

## 2.2   Regressions with Simulated Data

In order to evaluate the quantitative predictions of the model, we simulate it for N=50 open economies, "states," for T=100 periods (corresponding to years) using a Cobb-Douglas production function with capital's share, $\alpha = 0.33$. We set $L_{it} = 1$ for all states $i$ and periods $t$. For the productivity process, we assume

$$\log(A_{it}) = (1 - \rho) \log(A_0) + \rho \log(A_{it-1}) + \sigma \, \epsilon_{it} \ , \tag{6}$$

where $\epsilon$ is a standard normal innovation, independent across states and periods.

---

[15]For example, including taxes, insurance, cost of heating/cooling, transportation, endowments of oil or minerals, agglomeration benefits etc. to the extent that these impact on the marginal return to capital investment.

[16]We checked empirically that for OECD countries the *level* of TFP (identified as the Solow-residual) is positively correlated with the *level* of capital (both averaged over 1970–2000) and that the *change* in TFP and the *change* in capital from 1970–1975 to 1976–2000 also are positively correlated. The correlations are 0.21 and 0.37, respectively.

The equilibrium $R_t$ satisfies $\Sigma_{i=1}^{50}(\frac{\alpha A_{it}}{R_t})^{\frac{1}{1-\alpha}} = K_t$, where $K_t$ is determined at $t-1$ and $K_{it} = (\frac{\alpha A_{it}}{R_t})^{\frac{1}{1-\alpha}}$. Having found $K_{it}$, we find $w_{it} = (1-\alpha)A_{it}K_{it}^\alpha$ and calculate $GNI_{it} = w_{it} + \phi_{it}R_tK_t$. Aggregate $GNI_t$ $(= GDP_t)$ is then found as $GNI_t = \Sigma_{i=1}^{50}GNI_{it}$. Finally, we use equation (3) to calculate $\phi_{it+1}$.

To initialize the process we choose an arbitrary $K_0$ and simulate the model for a number of years until it converges to a steady-state value. We set the initial level of productivity in each state $A_0 = 1$ (a normalization) and the initial ownership share of each state $\phi_{i0} = 1/50$. For the parameters that govern the productivity process, we choose $\rho = 0.99$ and $\sigma = 0.02$. The standard deviation of productivity is chosen to generate state level output volatility that match the observed volatility in the data. We use $s = 0.20$ and $\delta = 0.05$. The calibration of these parameter values is guided by aggregate and state-specific data moments.

We perform cross-sectional regressions using the simulated values for 50 states. We perform 2 sets of regressions. "*Change regressions*" consider the change in the output/income ratio as a function of growth. These regressions are motivated by equation (2) which predict a clear relationship between the change in the output/income ratio and output growth. This relationship is the sharpest prediction of the model as it involves only observable variables. We also estimate "*level regressions*," where we consider the relationship of the output/ratio to past output and ownership motivated by equation (1). Because ownership shares are not observed the empirical predictions are less sharp and the simulations are needed in order to find quantitative implications.

We performed 200 regressions (from 200 simulations) and report the average coefficients and the standard deviations across the 200 simulations. Table 1 shows the results of a regression of the change in the output/income ratio average from the second-to-last decade to the last decade regressed on the growth in output over the second to last decade. These "years" are chosen to match the empirical regressions in Table 5. (The choice of specification is discussed in the empirical section below.) We consider the predicted coefficients for changes the more important implications of our model. For instantly observed changes our model predicts a coefficient near 0.33 but here we find a significant coefficient of 0.08—the passing

of time results in a smaller coefficient. Column (2) adds the output/income ratio of the previous decade. We find a coefficient of 0.13 to growth and a coefficient to the lagged output income ratio of –0.44. This implies a half-life for output/income deviations (from the average of unity) of about 15 years.

Table 2, column (1), displays results from regressing the log average output/income ratio in the last 20 years on log average output from the 4 preceding years. (As before "years" are chosen to match the empirical regressions in Table 7.) We find a statistically significant coefficient of 0.05 implying that high output states have higher output than income and, therefore, are net recipient of out-of-state capital. In other words, capital flows to "rich" states on average. In column (2), we add the lagged log-ownership share. In the actual data as well as in the simulated data, high output regions tend to have high ownership shares, so to limit collinearity, we use ownership shares that are averaged over data five "decades" ago.[17] We get a negative significant coefficient of –0.14, implying that states with an ownership share 1 percent above average will tend have an output/income ratio 0.14 percent below average 50 years later.

We performed sensitivity analysis by changing parameter values and initial arbitrary values. Overall, the results are qualitatively robust—in particular, the results of the change regressions are very robust. The levels regressions are somewhat sensitive to the size of the productivity shocks (the larger shocks, the larger the coefficient to lagged output in Table 2) and the depreciation rate (typically, smaller coefficients with high depreciation).

# 3  Empirical Analysis

The raw data series were obtained from the Bureau of Economic Analysis (BEA), unless otherwise stated. All nominal variables are converted into 2000 prices using the consumer price index.[18] We provide a detailed description of the variables in the data appendix.

---

[17]More precisely we average over periods 39–49 where the left-hand side is averaged over periods 81–100.

[18]A quantity index for real GDP-growth is available for states but our specification captures the effect of, for example oil-price variation on capital flows, which we would substantially miss if we used quantity

State-level GDP, denoted Gross State Product (GSP), is published by the BEA as part of the U.S. state-level national accounts. GSP is derived as the sum of value added originating in all industries in the state, thus, it is exactly the state-level equivalent of GDP. GSP numbers are based on income generated in establishments and the main sources are industrial censuses such as the census of manufactures. GSP is available for the years 1977–2000. Previously published, but no longer updated by the BEA, GSP is available since 1963, but that data is not fully compatible with the data post 1977 and hence we use this data only in a descriptive sense.

Our main measure for income is state-level personal income, SPI, which is based mainly on administrative-records data and on data from censuses and surveys. SPI is derived by adding personal earnings, government transfers and dividend, interest and rental income and subtracting contributions to government social insurance. While it might seem preferable to use approximate GNI numbers for easier comparison to country-level data, we prefer to focus on the results based on simple SPI since a large number of imputations are needed for our approximation of GNI. In the appendix we show the relationship between GNI and GDP in the aggregate U.S. National Income and Product Accounts, and we discuss the calculation of GSP and SPI in detail.

## 3.1   The Empirical Output/Income Ratio

We calculate the output/income ratio for each U.S. state year-by-year, which allows us to study the patterns of inter-state capital income flows over time. The variables SPI and GSP contain aggregate (U.S.-wide) components—in particular, the burgeoning U.S. balance-of-payments deficits—that may vary over time and affect the output/income ratio for individual states. These aggregate effects are not of interest to us in the context of inter-state capital mobility. To correct for this, we normalize the output/income ratio:

$$\text{Output/Income}_{it} = \frac{\text{GSP}_{it} \, / \, \text{SPI}_{it}}{\text{GSP}_{t} \, / \, \text{SPI}_{t}},$$

indices.

10

where

$$\text{SPI}_t \,=\, \Sigma_i \,\text{SPI}_{it}, \quad \text{GSP}_t \,=\, \Sigma_i \,\text{GSP}_{it}\,.$$

The ratio $\text{Output/Income}_{it}$ captures state $i$'s output/income ratio in year $t$ relative to the aggregate U.S. output/income ratio.

## 3.2  Graphical Evidence: 1963–2000

Figure 1 shows the output/income ratio and the growth rates for eight U.S. Census regions relative to the average (normalized to unity) across states. We aggregate to regions in order to get a manageable amount of graphs. The Southwest region had relatively high growth in the 1960s while the Great Lakes and New England regions had relatively low growth. For New England, this situation rapidly reversed in the 1980s while the Great Lakes regions only slowly recovered to reach the middle of the field by year 2000. The figure also reveals that New England, the Mid East, and the Great Lakes regions consistently have lower output than income, while other regions exhibit higher output than income. The general pattern corresponds well with the historical pattern of high output and income in the central and Northeastern states around the turn of the century—see North (1961). Part of this income is likely to have been invested in other regions, resulting in capital income flows from those regions in the later part of the 20th century.

A significant change in the output/income ratio relative to other regions is found for the Great Lakes. This region saw a steady decrease in the ratio throughout the 1960s and 1970s moving from above to below average.[19] Another significant change is the decline in the output/income ratio for the Southwest at the same time as the output/income ratio increased in New England. These patterns are exactly what our model would predict conditional on the growth patterns. The Great Lakes region throughout our sample was a laggard in terms of relative growth. This region should, according to our model, have been a net supplier of capital to other regions and, consequently, have experienced a slowly declining

---

[19]We don't display further details, but a closer study reveals this pattern to mainly be driven by Michigan, likely due to the car industry in Detroit attracting significantly less capital after 1970 than it did earlier.

output/income ratio—exactly as we observe. New England, on the other hand, experienced a rapid reversal of fortune in output growth in the 1980s (the "Massachusetts miracle") and the output/income ratio of New England increased rapidly. The pattern for the Southwest is the opposite of that found for New England which is also consistent with our model.

The large changes in oil prices that occurred during the period 1973–74 and 1979–87 are clearly visible in Figure 1. The output/income ratio of the Southwest region, which contains most of the major oil-producing states, increases due to the oil price hikes in the 1970s and then declines steeply in the years following the Iranian revolution in 1979.

Figure 2 explores directly if oil price spikes were reflected in changes in the output/income ratio for states with high output of oil ("oil-states"). We plot the average world price of crude oil and the output/income ratio for the oil-states Alaska, Louisiana, and Wyoming for the years 1963–2000. There is a clear pattern with the output/income ratio of these states increasing following (with about a three years lag) steep increases in the price of oil and *vice versa*. This pattern is consistent with oil exploration having been financed by other states which in periods of high oil prices receive relatively higher factor income from the oil states.

The graphical evidence is consistent with the historical development of the U.S. states. Romans (1965) constructs state-level "current accounts" for U.S. states for 1953 and 1957 and finds that investment minus saving (i.e., net capital inflows) was very large and positive for southern states and oil states in the 1950s. [20] One may notice from Figure 1 that even during the period of the mid-1980s where the growth rate of New England was about twice the national average, the output/income ratio for New England stayed below unity. This is consistent with our model when net capital flows are large and New England was a net

---

[20]It would be a major challenge to construct state-level current accounts today. Romans picked the two cycle-peak years of 1953 and 1957. His total investment estimates for each state are calculated by aggregating investment in manufacturing, mining, railroads, other transportation, public utilities, communications, agriculture, and construction. He uses annual surveys for some industries and balance sheets of companies (railways, utilities, etc.) for others. For industries where neither is available, he imputes from aggregate investment figures utilizing state-level wages and salaries for that particular industry. His saving estimates are based on state-level data, when available, on currency and bank deposits, saving and loan shares, private insurance and pension reserves, consumer debt, securities loans, mortgages, and bank debt, and involves a large number of imputations.

# Figure 1: Output/Income Ratio, U.S. Regions



**New England**

Growth of GDP per capita

Output/Income

**South West**

Output/Income

Growth of GDP per capita

**Great Lakes**

Growth of GDP per capita

Output/Income

**Plains**

Growth of GDP per capita

Output/Income

**South East**

Growth of GDP per capita

Output/Income

**Mid East**

Growth of GDP per capita

Output/Income

**Rocky Mountains**

Output/Income

Growth of GDP per capita

**Far West**

Output/Income

Growth of GDP per capita

13

Figure 2: Output/Income Ratio, Oil Regions
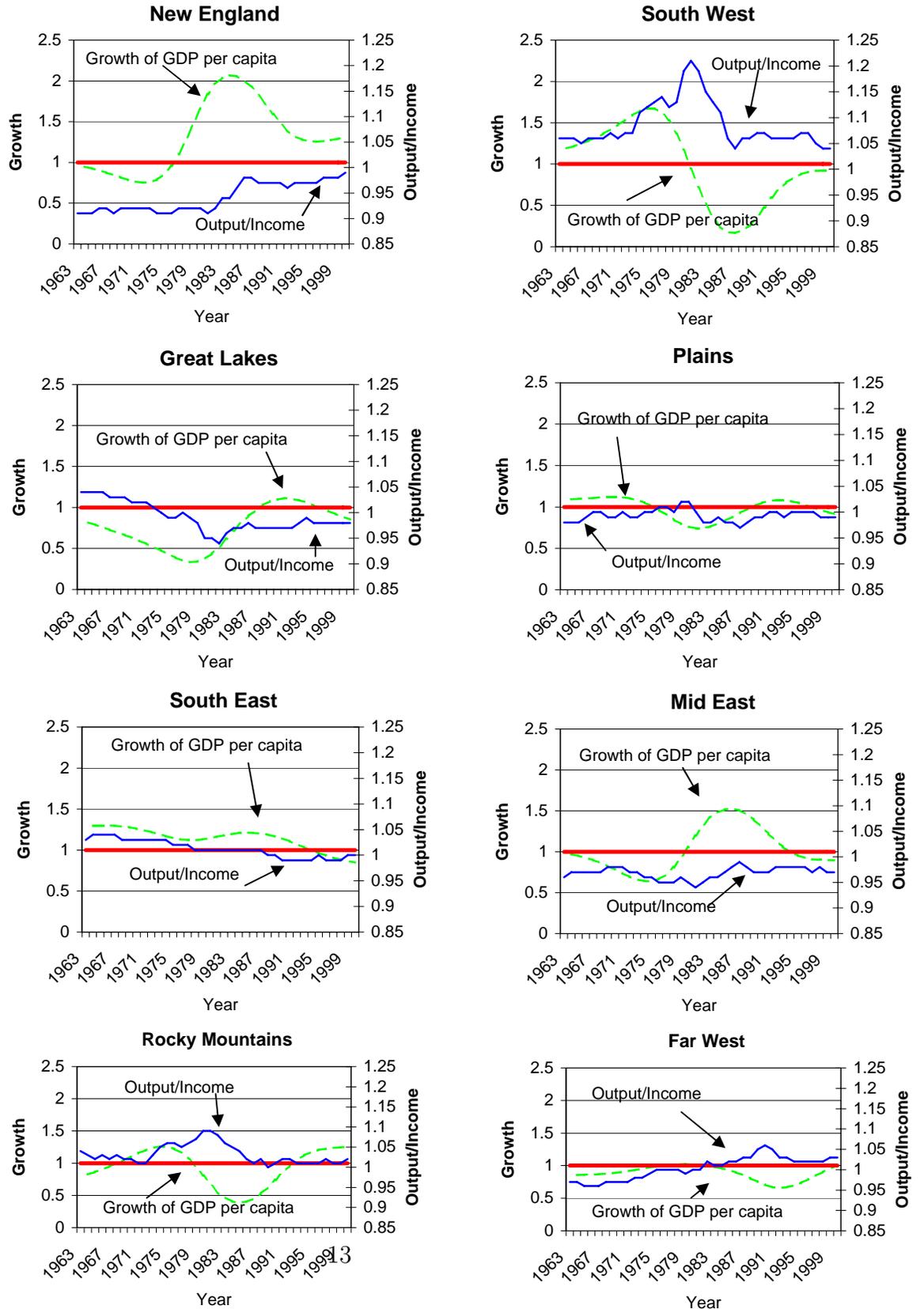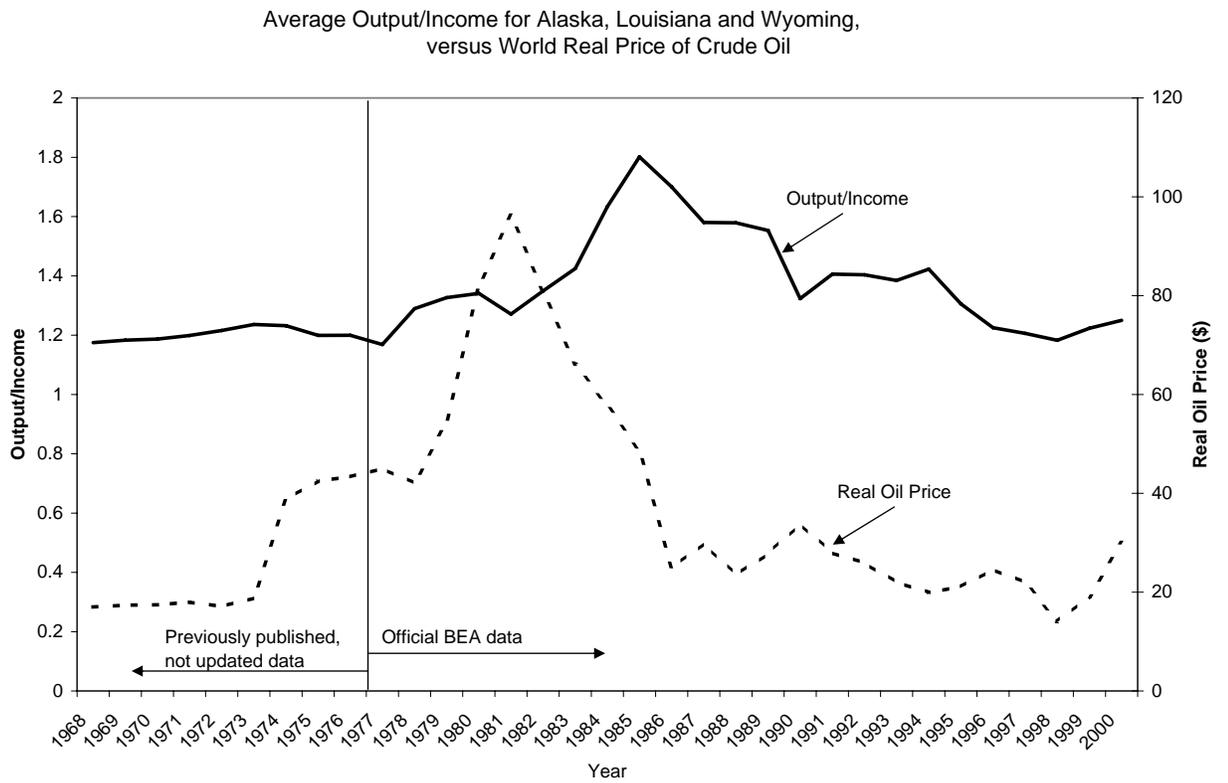
Average Output/Income for Alaska, Louisiana and Wyoming,
versus World Real Price of Crude Oil



14

supplier of capital to other states in the 1950s and remained a net creditor at the beginning of the 1980s (corresponding to an above average value of $\phi_i$ in the model).

Consistent with our approach, the states with large negative values of saving minus investment in the 1950s tend to be the states with high output/income ratios in the 1980s and 1990s, as shown by Kalemli-Ozcan, Turan, and Sørensen (2008), who also argue that the "catch up" growth of the 1950s and 1960s mainly was over by the late 1980s.

## 3.3   Specification of Regressions

We estimate specifications similar to those of Tables 1 and 2 using actual data.[21] We fit cross-sectional regressions to data averaged over long time spans in order to minimize the potential effects of business cycles and measurement errors. In choosing the interval length we face a trade-off. For long enough intervals, adjustment costs in investments can be taken to be negligible and business cycle effects will average out.[22] However, even if there is ample evidence that (relative) productivity shocks are persistent, these shocks do not last forever and we may obtain higher variation in growth rates if we consider shorter intervals.

The main regressors for the change regressions are output growth, the lagged output/income ratio, and growth of population and retirees. Ideally, we would like to include stock-holders but retirees are, per definition, not in the labor force but hold assets. Based on equation (5) we expect that the output/income ratio changes with the normalized number of retirees at a similar rate as it changes with growth, albeit with a negative sign.[23]

Our model is couched in terms of stock holders with average assets and labor force with no assets and the empirical data do not provide such details. However, sifferences in population growth are mainly due to migrants and migration (especially when controlling in

---

[21]We leave out Alaska, Hawaii and Delaware, in order to be consistent with the level regressions.

[22]We avoid using overlapping samples for the regressor (output) and the dependent variable (the output/income ratio) for the simple reason that output is used in the numerator of this ratio and measurement error would lead to a spurious positive correlation of output with the output/income ratio.

[23]Equation (5) contains the term $-\alpha\, dS/L$ or $\Delta S/L$ in discrete time. If $\Delta S = \Delta\text{Retirees} + \Delta\text{Other Asset Holders}$, the coefficient to $\Delta\text{Retirees}/L$ would be expected to be $-\alpha$ even if the contribution from unobserved Other Asset Holders/$L$ goes into the error term.

the regressions for the number of retirees) is dominated by young workers without assets and based on equation (5), we expect the output/income ratio to change with migration with a proportionality factor similar to that of growth and with an identical sign.[24] However, if migrants bring some assets the coefficient will be smaller—if migrants bring average assets the coefficient to population growth would be near 0. Similarly, if retirees hold less assets than the average individual we would expect a coefficient smaller than that of growth and vice versa if retirees hold more assets.[25]

For the level regressions the main regressor is lagged output per capita. Reliable measures of net ownership are not available, so we examine whether indicators of historical wealth predict current output/income ratios. As our measure of historical wealth, we use the logarithm of the per capita value of dividend and interest income by state, averaged over 1939–1949.[26] We have access to this data since 1929 and we prefer values that are distant from the income data used to calculate the current output/income ratio and not too close to the 1977–1980 period to avoid high collinearity with the output data. For that reason, and in order to avoid the financial upheavals of the Great Depression, we chose the 1939–1949 sample. The results are not very sensitive to exactly which sample is chosen, except that the coefficient to this variable is smaller if we use the data from the 1930s.

We include other controls that are not present in the model, but are important in reality: oil deposits are highly concentrated in relatively few states that likely obtain a large fraction of the required capital from outside sources—this is most clearly observed in Alaska where the large multinational oil companies have made large investments. We do not have direct measures of the value of natural endowments of oil and minerals, so we approximate it for each state by the share of the gross product of the oil and mineral extraction sector in total

---

[24]The correlation between population growth and migration across states in the 1990s is 0.96.

[25]For example, if each retiree holds 50 percent of the assets of an average stock holder the effective change in $S$ due to retirees would be only 0.5 times the change in number of retirees. The impact on the output/income ratio according to the model would then be $-0.5\alpha$.

[26]The historical dividend and interest income data was made available to us by the BEA. The BEA publishes the sum of dividend, interest, and rent income, together with other income data, going back to 1929. We prefer to use data that does not include rental income, because this type of income is mostly imputed rental income of locally used and owned property.

16

GSP averaged over averaged over 1977–1980. In order to dampen the impact of outliers, we use the transformation $\log(1 + x)$ for the oil share. As a measure of the number of retirees, we use the share of residents aged 65 and above.

## 3.4   Descriptive Statistics

In Table 3, we tabulate per capita dividend and interest income by state averaged over 1939–1949 (no data available for Hawaii and Alaska), GSP growth per capita averaged over 1981–1990, GSP per capita averaged over 1977–1980 and the output/income ratio averaged over 1981–2000. The table reveals very large geographical differences in dividend and interest income with the Northeastern states displaying much higher levels than Southern states. Delaware is an extreme outlier. GSP 1977–1980 also shows high variation with Alaska having an extremely high value of about 63,000 dollars per capita. Next highest is Wyoming—another oil state—at 43,000. These oil states also exhibit the highest output/income ratios. The lowest ratio is found for Florida, which reflects capital income received by retirees who are no longer in the work force.

Table 4 reports the mean, maximum, minimum, and standard errors (across the 50 states) of the output/income ratio and all the regressors. The output/income ratio has a mean of about 1 by construction and has a standard deviation of 0.12.[27] This is a large amount of variation because a value of 1.12 means that 12 percent of value produced shows up as income in other states on net. GSP 1977–1980 also shows large variation with the value of the output of the most productive state being more than 3 times than that of the least productive state. GSP growth from 1981 to 1990 has a standard deviation of 15 percent, which means that several states grew more than 1.5 percentage point per year faster than the average state during that decade. There are large differences in the change of retirees and, in particular, population growth across states.

---

[27]The mean is not exactly equal to 1 due to normalization by the aggregate rather than the average U.S-wide values.

## 3.5 Results from Empirical Regressions

*Change Regressions*

Table 5 explores whether the change in the output/income ratio is explained by per capita output growth and lagged output/income ratios and whether the estimated coefficients are similar to those obtained from regressions on the simulated data.[28] The regressions are performed for 47 states because we do not have dividend and interest income for Alaska and Hawaii, and Delaware is very atypical. Alaska is also very atypical, with an extremely high share of GDP due to oil-extraction.

The effect of (lagged) GSP growth from 1980 to 1990 is statistically significant and this variable alone explains 41 percent of the variation in the output/income ratio. In autarky, the output/income ratio would be constant and equal to 1.0 and no regressors would be significant. The significant positive coefficient to lagged GSP growth supports our interpretation that an increase in TFP brings about growth and capital inflows. The estimated coefficient of about 0.3 implies that a state which from 1980 to 1990 grew 10 percent faster than the average state (1 percent faster during the 1980s at the annual rate) would have an output/income ratio that would be 0.03 higher in the 1990s than in the 1980s.[29] For international data, Glick and Rogoff (1995) regress changes in gross investment and current accounts on the changes in TFP and find that gross investment reacts stronger than the current account which is add odds with theory under the assumption of perfect capital mobility and existence of persistent productivity shocks.[30] While we are not able to run exactly the same regression as Glick and Rogoff (due to the fact that we cannot calculate the Solow residual) our results, nonetheless, indicate that interstate capital movements are much better described by the frictionless model than the international capital movements.

We can get a rough order of magnitude of the net capital income flows involved as follows:

---

[28]We include a constant in the regression so the estimated effect of, say, output growth can be interpreted in line with the model prediction for a change in output keeping the aggregate constant.

[29]For example, North Carolina's per capita GDP grew 13 percent faster than average GDP over the 1980s.

[30]Gruber (2000) even finds *no* responsiveness of the current account to real growth rates for a panel of OECD countries during 1975–2000.

the average per capita output of a state over our sample is about 30,000 dollars. An increase in the output/income ratio of 0.03 corresponds to 900 dollars worth of capital income being paid by residents of the average state to other states, annually. If this increase is mainly caused by a change in net ownership rather than a surge in productivity, we can expand on the quantification. If the return to capital is (say) 10 percent, this would imply that capital in the order of 9,000 dollars per capita were financed on net by other states.

In the second column of Table 5, we add (lagged) output/income from 1981 to 1990. This renders the coefficient to growth smaller at 0.09 while the coefficient to lagged output/income takes a value of –0.42, which implies a half-life for the reversion of the output/income ratio to unity of 15 years. These values are very close to those found by simulating the theoretical model and regressing on simulated data (see Table1).

In the third column, we add the rate of population growth. The estimated coefficient to population growth is 0.08 with a $t$ statistic of 1.83. This coefficient is identical to that of growth which is exactly the prediction of the model if migrants arrive with little assets.[31]

In the last column, we add the change in number of retirees normalized by population. This estimated coefficient is negative, as predicted, although the point estimate is much larger than predicted. However, the coefficient is not precisely estimated and not significantly different from 0.

*Change Regressions–Panel Specification*

We show the results of panel regressions where the data has been averaged over fewer years—these regressions provide more degrees of freedom although we expect the model to be too simple to match, say, annual data. In Table 6, we show regressions where each period is an average over 10-year intervals, 7-year intervals, and 5-year intervals, respectively. Column (1) repeats the last column of Table 5 for easy reference.

---

[31]We attempted to also include as a regressor the rate of net inter-state migration as a percent of state population $1975-1980$ in order to directly examine the issue of migration. The migration variable is, however, so closely correlated with population growth that we obtained non-sensible results due to multi-collinearity. Substituting the population growth rate with net inter-state migration gives very similar results.

Column (2) displays the results for 7-year periods which doubles our number of data points. The estimated coefficient to lagged growth is larger and very close to the predicted size from the simulated data. In this larger sample, this coefficient is now strongly significant. The coefficient to the lagged ratio measures how much the output/income ratio would revert towards unity, ceteris paribus, during one time period. When the length of the time period becomes shorter this coefficient should become smaller and this is what we find. The estimates imply similar half-lives as those for the first column for the speed of reversion of the output/income ratio to unity. The coefficient to population growth declines with the interval length which may be due to limited variation in population growth at shorter intervals. The estimated value in column (2) is still consistent with our model and statistically significant. The coefficient to changes in number of retirees declines but this coefficient is numerically larger than predicted and now clearly insignificant. For the 5-year intervals, reported in column (3), the coefficients to lagged output and the lagged output/income ratio are still of the correct size and significant while the population and retirees variables now are very far from being significant.

We verified that the panel regressions do not give meaningful results at higher frequencies. This is to be expected because we ignore business cycle variations and adjustment costs in our model. All in all, the results of the panel regressions are robust to the choice of period length—when it is 5 years or longer—and are consistent with our model.

*Level Regressions*

The level regressions are presented in Table 7. Column (5) displays the results for our main specification, but in order to evaluate the impact of individual regressors as well as robustness, we show in column (1) the regression of the output/income ratio on (a constant and) Log Average GSP 1977–1980 and add regressors one-by-one in the remaining columns in the order in which we found the regressors to be of interest a priori.

In column (1), Log Average GSP 1977–1980 is statistically significant at conventional levels. This variable explains 34 percent of the variation in the dependent variable according

to the $R^2$ and the coefficient is positive. A positive sign is consistent with capital flowing to productive states with high output. The coefficient is about 0.3, which implies that a state with output 10 percent above average has a ratio of output/income 3 percent above average. Since the output/income ratio is 1 on average this implies that a state that produces 50 percent more than the U.S. average is predicted to have an output/income ratio of about 1.15, which means that approximately 15 percent of the state's output accrues to income in other states. Thus, the estimated coefficient is economically large and meaningful. Compared to the estimate from simulated data the coefficient to GSP 1977-1980 is significantly larger; however the result matches the qualitative finding of our simulations that capital tends to flow to high output states.

Dividend and interest income, added in column (2), predicts the current output/income ratio negatively, as predicted, with a very high $t$-statistic even though the historical variable refers to observations more than 50 years ago. The estimated coefficient implies that states with a 10 percent higher than average level of interest and dividend income in the 1940s has an output/income ratio that is almost 1 percent lower today. If states with relatively high income in the past invested their savings in states with high total factor productivity, this is what we would expect to find. One might find it surprising that the effect is as long lasting as this result indicates but in our regression using simulated date we also found ownership shares 50 years in the past to be highly significant. (We can't compare the actual coefficients because the historical dividend and interest income data doesn't correspond exactly to ownership shares.)

The coefficient to oil share, in column (3), is likewise highly statistically significant. The inclusion of this variable lowers the coefficient to GSP 1977–1980 somewhat relative to column (2), but this is exactly what our model would lead us to believe: an oil price shock is a direct measure of productivity of capital in the "oil states." The impact of oil, as measured from the regression, is large—the coefficient of about 0.56 implies that a state, such as Wyoming, with a fraction of oil in GDP of 0.25, has an output/income ratio of 1.14, *ceteris paribus*, implying that 14 percent of output shows up as income in other states due

to the effect of this variable alone. Wyoming's output is on the order of 40,000 dollars per capita, and 14 percent of that is about 6,000 dollars, which—if we assumed a rate of return of 10 percent, would imply that capital in the oil-extraction sector in the amount of 60,000 dollars per capita is owned by out of state residents. While this number is based on several imputations and not likely to be exact, it highlights that on average the amount of out-of-state capital invested in oil-extraction (capital that is installed in Wyoming but owned by other states) is very large.

Adding percent retirees, in column (4), we find a negative significant coefficient in line with our model. This supports the notion that retirees receive income from savings but contribute little to output. This coefficient is also large in economic terms. A state like Florida has almost 50 percent more retirees than average and our results predict that Florida has an output/income ratio 5 percent below average because of the large number of retirees in the state.

## 3.6  Robustness: Measures of Income and Further Controls

*Measuring income*

The validity of the way we interpret the results is highly dependent on the difference between output and our income variable being a reasonable approximation to net capital income from other states, so we find it important to demonstrate that our main results are robust to reasonable alternative ways of calculating our income variable.

A simple modification of SPI that may make the data correspond better to GNI is to use SPI *minus* federal transfers, rather than simply SPI. The transfers included in SPI involve redistribution (typically) from richer to poorer individuals and, in particular, redistribution from younger to older individuals. A second modification, which is the closest approximation to "state-level GNI," is to calculate "state income," which is the income that would have been available for consumption by the residents of the state had there been no fiscal intervention on the part of the federal government following Asdrubali, Sørensen, and Yosha (1996). We approximate GNI as "State income" plus retained corporate earnings. Retained corporate

earnings are not available by state and we impute the state-level numbers from aggregate data.[32] One last modification, that will make the difference between SPI and GSP correspond more closely to the capital income component of factor income flows (while making it less similar to GNI) is to subtract from the SPI of state $i$ the (net) income that commuters living in state $i$ earn in other states, since commuter's income is equivalent to the foreign earnings of country's residents. We are able to do so using the "adjustment for residence" data from the BEA. This adjustment is equal to the wage income earned by residents of state $i$ that work in other states (not $i$) minus the wage income earned by residents of other states (not $i$) that work in state $i$. Thus, it is the wage component of a state's "foreign" (from other states) net factor income.[33]

In Table 8, we explore whether the *level regressions* are sensitive to the precise definition of "income" in the denominator of the output/income ratio. Overall, the estimates are quite robustly estimated, with the signs and relative magnitudes showing little variation across the columns. Column (1) replicates the fourth column of Table 7. In column (2) personal income is adjusted for federal transfers. In this column, the estimated impact of retirees in the population becomes statistically insignificant which indicates that a large part of the income of retirees consists of federal transfers (notably social security and medicare). In column (3), we adjust personal income for cross-state commuters' wage income. This adjustment lowers the coefficients to dividend and interest income and GSP 1977–1980, although these regressors are still statistically significant. One might argue that this choice of income data fits the model more directly and the lower coefficient estimated for this choice is actually closer to that found using simulated data. In column (4), approximate GNI is

---

[32]See the data appendix for details.

[33]A different approach is to use direct estimates of net external assets for U.S. states 1971–2001 imputed by Duczynski (2000). These estimates are based on personal dividend, interest, and rental income. Personal dividend income constitutes only about 5 percent of total personal income—a fraction much lower than the share $\alpha$ (typically 0.33) of output accruing to capital. The resulting estimates of net capital income flows may well underestimate the extent of net capital income flows for some states because capital income flows between firms in different states may never enter personal property income. In spite of these differences, using Duczynski's data in regressions similar to the ones reported result in qualitatively similar results, although the exact coefficients estimated can not be compared—see the working paper version of this article for details.

used rather than personal income but the estimated coefficients are quite similar to those of column (1) except that the fraction of retirees is not statistically significant—likely due federal transfers not being part of approximate GNI. Overall, our results are robust to these different definitions of income with some adjustments actually making the results closer to the simulation benchmark. The *change* regressions give results that are even more robust to the definition of income and we do not display the results.[34]

*Additional Controls*

For further robustness check, we consider the following variables whose inclusion in the regressions do not change the results and for which details are therefore not tabulated.

*Geography:* Historically, the northern states were the seat of U.S. industrialization and much wealthier than the south. Anecdotal evidence suggests that capital has moved to the U.S. South as labor productivity was catching up with the North due to improved education as described by, e.g., Connolly (2003) and Caselli and Coleman (2001). We define a dummy variable, which takes the value 1 for New England, Mid-East, and Great Lakes and 0 for other regions.[35]

*Sectoral Shares other than oil:* Historically, agricultural areas have often been laggards in terms of TFP growth, but this may not be true in recent periods for the United States. We include the share of agriculture in GSP in the same way as oil and mineral extraction. We further include the share of manufacturing in GSP.

*Human Capital:* Residents in states with a relatively high number of educated individuals may have higher output relative to their income if individuals with college degrees (partially) financed their student loans from savings in other states or human capital may be correlated with TFP. We use human capital measured as the number of college graduates in a state

---

[34]The *change* regressions show almost no sensitivity at all to the definitions of income and we do not display the details here. The details are available in the working paper version of the (NBER WP 11301) paper.

[35]We constructed this dummy variable after experimenting with dummy variables for all regions in multivariate regressions including our other regressors. The estimated effects were consistent with these three regions being different from the remaining regions. This result, of course, corresponds to the fact that these are the three regions with low output/income ratios.

relative to population in 1989 (the first available year for this variable).[36]

# 4    Conclusion

In spite of the surge in international capital flows in the last decade their magnitude is still below what typical models predict and they go in the "wrong" direction. Recent theoretical work attempting to have a better characterization of the real world has shifted the attention to portfolio models of the current account.

We adopt a different approach. We develop a simple (constant savings rate) dynamic general equilibrium model with persistent productivity shocks and full diversification of capital income. In this model, relative investment is determined by relative productivity, independently of relative savings. Our model predicts—as the new portfolio models—that net foreign ownership positions are mean-reverting. Essential for our result is that capital is fully diversified such that net flows are not primarily determined by risk considerations.

An advantage of our framework is that it is easily related to the data. We test the model using data from the U.S. states. The model predicts that capital flows to fast growing states from slow growing states and as a result high growth states pay capital income to other states. With persistent productivity shocks high output—"rich"—states end up being net debtors.

At the country level, foreign asset and liability positions in the OECD has increased at a remarkable rate in the 1990s. Nonetheless, almost all countries hold amounts of foreign assets below the level of GDP (with Ireland being a notable exception).[37] Why foreign asset holdings are "too low" is one of the biggest puzzles in international finance. Our evidence suggests that capital flows and ownership patterns across U.S. states are consistent with a simple frictionless neoclassical model. Therefore, the small size and "wrong" direction of net international capital flows is likely due to frictions associated with national borders.

---

[36]All the robustness exercises are available from www.uh.edu/skalemli and on request.

[37]Typical neoclassical models imply that an average state should hold foreign capital in an amount of about 3 times GDP.

# References

Alfaro, Laura, Sebnem Kalemli-Ozcan, and Vadym Volosovych (2008), "Why Doesn't Capital Flow from Rich to Poor Countries? An Empirical Investigation," *The Review of Economics and Statistics* 90, 347-368.

Asdrubali, Pierfederico, Bent E. Sørensen, and Oved Yosha (1996), "Channels of Interstate Risk Sharing: United States 1963–90," *Quarterly Journal of Economics* 111, 1081–1110.

Atkeson, Andrew and Tamim Bayoumi (1993a), "Private Capital Markets and Adjustment in a Currency Union: Evidence from the United States," in Paul R. Masson and Mark P. Taylor, eds., *Policy Issues in the Operation of Currency Unions,* New York: Cambridge University Press.

Atkeson, Andrew and Tamim Bayoumi (1993b), "Do Private Capital Markets Insure Regional Risk? Evidence from the United States and Europe," *Open Economies Review* 4, 303–324.

Beemiller, Richard M. and George K. Downey (2001), "Gross State Product by Industry, 1992–99," *Survey of Current Business* 81 (August), 159–172.

Bernard, Andrew, Stephen Redding, and Peter Schott (2005), "Factor Price Equality and the Economies of the United States," CEPR Working Paper No. 5111.

Bertocchi, Graziella and Fabio Canova (2002), "Did Colonization Matter for Growth? An Empirical Exploration into the Historical Causes of Africa's Underdevelopment," *European Economic Review* 46, 1851–1871.

Blomstrom, Magnus, Robert E. Lipsey, and Mario Zejan (1996), "Is Fixed Investment the Key to Economic Growth?" *Quarterly Journal of Economics* 111, 269–276.

Bound, John and Harry J. Holzer (2000), "Demand Shifts, Population Adjustments, and Labor Market Outcomes during the 1980s," *Journal of Labor Economics* 18, 20–54.

Bureau of Economic Analysis (1999), *State Personal Income 1929–1997*, U.S. Department of Commerce, Economics and Statistics Administration.

Caselli, Francesco and Wilbur John Coleman II (2001), "The U.S. Structural Transformation and Regional Convergence: A Reinterpretation," *Journal of Political Economy* 109, 584–616.

Connolly, Michelle P. (2003), "Human Capital and Growth in the Post-Bellum South: A Separate but Unequal Story," Duke University, mimeo.

Devereux, Michael, and Alan Sutherland (2006), "Country Portfolio Dynamics," University of British Columbia, mimeo.

Duczynski, Petr (2000), "Capital Mobility in Neoclassical Models of Growth: Comment," *American Economic Review* 90, 687–694.

Glick, Reuven and Kenneth Rogoff (1995), "Global versus Country-Specific Productivity Shocks and the Current Account," *Journal of Monetary Economics* 35, 159–192.

Gourinchas, Pierre-Olivier and Olivier Jeanne (2006), "Capital Flows to Developing Countries: The Allocation Puzzle," University of California, Berkeley, mimeo.

Gruber, Joseph (2000), "Increased Current Account Dispersion: Differential Growth, Demographic Dispersion, or Greater Financial Integration?" Board of Governors, Federal Reserve Bank, mimeo.

Kalemli-Ozcan, Sebnem, Belgi Turan, and Bent E. Sørensen (2008), "Where Does Capital Flow? A Comparison of U.S. States and EU Countries 1950–2000," in Lars Jonung, Christoph Walkner, and Max Watson, eds. *Building the Financial Foundations of the Euro.* London: Routledge.

Kraay, Art and Jaume Ventura (2000), "Current Accounts in Debtor and Creditor Countries." *Quarterly Journal of Economics* 115, 1137–1166.

Lucas, Robert (1990), "Why doesn't Capital Flow from Rich to Poor Countries?" *American Economic Review* 80, 92–96.

North, Douglas (1961), *The Economic Growth of the United States 1790–1860,* New York: W.W. Norton.

Obstfeld, Maurice and Alan M. Taylor (2005), *Global Capital Markets: Integration, Crisis, and Growth*, New York: Cambridge University Press.

Prasad, Eswar S., Raghuram G. Rajan, and Arvid Subramanian (2007), "Patterns of International Capital Flows and Their Implications for Economic Development," *Proceedings of the 2006 Jackson Hole Symposium*, 119–158.

Reinhart, Carmen M. and Kenneth Rogoff (2004), "Serial Default and the 'Paradox' of Rich-to-Poor Capital Flows," *American Economic Review: Papers and Proceedings* 94, 53–58.

Romans, John T. (1965), *Capital Exports and Growth among U.S. Regions,* Middletown: Wesleyan University Press.

Tille, Cedric and Eric van Wincoop (2008), "International Capital Flows," CEPR Discussion Paper No. 6705.

**Appendix A: Relation between GDP and GNI of the United States.**

|   | U.S. GDP (Gross value of production physically *in* the United States) |
|---|---|
| + | Income from U.S. owned direct investment in other countries |
| – | Income of foreign owned direct investment in the United States |
| + | Income from U.S. owned portfolio investment in other countries |
| – | Income of foreign owned portfolio investment in the United States |
| + | Income from U.S. government investment in other countries |
| – | Income of foreign investment in United States government assets |
| + | Wage and salary earned in other countries by residents of the United States |
| – | Wage and salary earned in the United States by residents of other countries |
| + | Taxes on production and imports (collected by the United States from foreign companies) |
| – | Taxes on production and imports (collected by foreign governments from U.S. companies) |
| = | U.S. GNI (Gross value of production *owned* by U.S. residents) |
| + | Subsidies – Indirect business taxes (domestic) |
| – | Corporate saving |
| – | Net interest |
| + | Personal interest income |
| – | Contributions for social insurance |
| + | Government transfers to persons |
| = | Personal Income |

Notes: (i) *Residents* of the United States contribute to U.S. GNI whether they are *citizens* of the Unites States or not and, while the number of foreign citizens in the United States is large, the total wage and salary of foreign residents in the United States is fairly small (less than 4 percent of total U.S. income payments to foreign countries in 2002).

(ii) Government investments abroad are mainly official currency reserves, while government liabilities are mainly treasury securities. For further details, see OECD (1993),"System of National Accounts Glossary 1993" and BEA (2003), "Preview of the 2003 Comprehensive Revision of the National Income and Product Account," Survey of Current Business, June 2003.

# Data Appendix

**GSP:** State-level GDP, denoted Gross State Product (GSP), is published by the Bureau of Economic Analysis (BEA). GSP is derived as the sum of value added originating in all industries in the state, thus it is exactly the state-level equivalent of GDP. See Beemiller and Downey (2001).

GSP is calculated from the income side of the accounts and contains three components: compensation of employees; taxes on production and imports (TOPI); and gross operating surplus (including noncorporate income). "Compensation of employees" consists mostly of employee wages and salaries *disbursements*; to keep consistency with the rest of the GSP components the BEA adjusts these disbursements to reflect production; i.e., when labor services were employed, rather than when they were actually paid. For most industries and GSP components, the estimates are based on *establishment* data (rather than company data) by state. Thus, GSP is calculated on a *"when accrued, where accrued"* basis.

GSP estimates are available for 1977–2000. GSP data exists for 1963–1976 as well, but is based on a different methodology which is inconsistent with the 1977–2000 estimates.

**SPI:** State-level Personal Income (SPI) is also published by the BEA. SPI is defined as the income *received* by, or on behalf of, all the residents of the state and is designed to be conceptually and statistically consistent with the U.S. national estimates of personal income.

The SPI estimates are primarily based on administrative-records data and on data from censuses and surveys. The data from administrative records (like Federally-administered transfer programs) may originate either from the recipients of the income or from the source of the income; for example, federal transfers may be reported by the federal government or by the recipient states or individuals. The data from censuses is mainly collected from the recipient of the income. Some data is reported and recorded by the recipient's place of work rather than by the recipient's place of residence. Therefore, adjustments are made to the data in order to reflect the recipient's place of residence. Most adjustments are directly applied to the series that the BEA publishes, but the largest adjustment, "Adjustment for residence" of earnings is reported separately.

SPI is derived as SPI=Earnings by place of work – Contributions for government social insurance (by employee and employer)+ Adjustment for residence+ Dividends, interest, and rent+ Personal current transfer receipts.

Persons (from "personal income") consist of individuals, nonprofit institutions that serve individuals, private non-insured welfare funds, and private trust funds. The wage component of SPI takes into account cross-state commuters, so that the wages of persons residing in a particular state but working elsewhere (another state, Canada or Mexico), even temporarily, are included in that state's personal income; see "net commuters' income" description below. Other components of SPI, like estimates of non-farm proprietors' income and of contributions for government social insurance by the self-employed are derived from source data that is reported by the tax-filing address of the recipient. This address is usually that of the proprietor's residence; therefore, the data is, in principle, recorded by place of residence. Thus, SPI is defined on a *"when earned, where earned"* basis. SPI is available for our entire sample.

**The difference between SPI and GSP:** Conceptually, the main difference between GSP and SPI is that while GSP is defined on a *"when accrued, where accrued"* basis, SPI is defined on a *"when earned, where earned"* basis. The methodology of estimating these series reflect the difference. This means that they are estimated using different data sources: GSP estimates are based on payrolls from establishment data, while SPI estimates are based on income from administrative-records and censuses. So although both are measured form the income side they are based on different data.

A few examples may clarify this difference. Suppose a machine produces widgets in Wisconsin. The output of that machine minus the cost of its inputs will be recorded as part of Wisconsin's GSP. But if the firm that operates the machine is partially owned by someone that lives in Ohio, where he or she reports dividend income for tax purposes, then this dividend income will show up in Ohio's SPI. Now suppose that the machine needs a worker to operate it. The workers wage is accrued to Wisconsin's GSP, but if he or she lives in Iowa, the salary will show up in Iowa's SPI.

**Federal Transfers:** This series is the sum of 11 different series, each of which we identify as measuring transfers from the U.S. federal government to individuals or state-specific institutions (typically governments).[38]

**Net Commuters' Income:** This series is denoted "Adjustment for Residence" by the BEA and is available for our entire sample. It is a component of SPI. The adjustment is equal to the wage income earned by residents of state $i$ that work in other states (not $i$) minus the wage income earned by residents of other states (not $i$) that work in state $i$. Thus, it is the wage component of a state's "foreign" (from other states) net factor income. The BEA estimates this series by using "Journey to Work" surveys, which are performed by the Census Bureau.

**State Income:** State income is calculated starting from the BEA data for SPI, which is pre-personal income tax but post- all other federal taxes as well as post- social security contributions and transfers. Therefore, we add to SPI personal and employer social security contributions and subtract social security transfers. We further add state non-personal taxes, in order to combine non-cancelling income of the state government and the residents of a state—the taxes collected by the government of the state are available for consumption by its residents, possibly in the form of public goods. Finally, we add the interest revenue on the state's trust funds. The detailed construction of State Income involves a large number of data sources and a number of imputations; see Asdrubali, Sørensen, and Yosha (1996) for details.

**Corporate Retained Earnings:** Corporate retained earnings of firms are reported by the BEA only at the aggregate U.S. level, and are available for our entire sample. We impute state corporate retained earnings by allocating the aggregate number to each state according to its share in aggregate personal dividend income.

---

[38]The series—published by the BEA and available for our entire sample—are: "Old age, survivors and disability insurance payments," "Railroad retirement and disability payments," "Workers' compensation payments (Federal and State)," "Medical payments," "Supplemental security income (SSI) payments," "Food stamps," "Other income maintenance," "Unemployment insurance benefit payments," "Veterans' benefits payments," "Federal education and training assistance payments (excl. veterans)," "Federal government payments to nonprofit institutions." The series for workers compensation includes some transfers which are not from the federal government but we did not attempt to correct for this.

**Historical Dividend and Interest Income:** Separate series of personal dividend income and personal interest income have been made available to us by Kathy Albetsky from the BEA for 1929–2000. The BEA publishes the sum of personal dividends, interest, and rent income by state in 1929–2000.

**Population:** This series is published by the BEA and is available for our entire sample.

**Oil Prices:** This series was obtained from the Energy Information Administration in the U.S. Department of Energy for 1968–2000.

**Oil Share:** The BEA publishes estimates of the value added in the "Oil and gas extraction" industry sector by state. "Oil Share" is the percent of this sector in GSP.

**Retirement:** The Census Bureau publishes age profiles of the population by state for 1970–2000 (unfortunately, we could not obtain the data for 1972). We use the number of people age 65 and above as our measure of retired persons.

**SPI–transfers:** SPI minus Federal Transfers.

**SPI–commuters' income:** SPI minus Commuters' Net Wage Income (Adjustment for Residence).

**GNI (approximation):** State Income from Asdrubali, Sørensen, and Yosha (1996) plus Corporate Retained Earnings.

Table 1: **Change in Net Capital Income Flows: Simulated Data**

Dependent Var.: Avg. Out./Inc. T–9 to T minus Avg. Out./Inc. T–19 to T–10

|                          | (1)    | (2)     |
|--------------------------|--------|---------|
| Output Growth T–19 to T–10 | 0.08 (0.04) | 0.13 (0.03) |
| Output/Income T–19 to T–10 | – – | –0.44 (0.10) |

Notes: The table reports the results of cross-sectional regressions for 50 "states" on simulated data. The specification parallels the regressions using actual data reported in Table 5, columns (1) and (2). A constant was included but is not reported. The coefficients are averages over 200 simulations and standard deviations across the 200 simulations are reported in parentheses. The simulated data are calibrated to match long-run trends in the aggregate U.S. economy and state-level output data. The data are simulated for T=100 "years." The left hand side is the logarithm of the ratio of GDP to GNI averaged over years T–9 to T minus the ratio of GDP to GNI averaged over years T–19 to T–10. "Output Growth T–19 to T–10" is the logarithm of state GDP in year T–10 minus the logarithm of state GDP in year T–19. "Output/Income T–19 to T–10" is ratio of GDP to GNI averaged over the years T–19 to T–10. See the text for parameter values.

Table 2: **Net Capital Income Flows: Simulated Data**

Dependent Variable: Log of Average Output/Income T–19 to T

|                         | (1)    | (2)    |
|-------------------------|--------|--------|
| Log Average Output T–23 to T–19 | 0.05 (0.02) | 0.09 (0.04) |
| Ownership Share T–61 to T–51 | – – | –0.14 (0.04) |

Notes: The table reports the results of cross-sectional regressions for 50 "states" on simulated data. The specification parallels the regressions using actual data reported in Table 7, columns (1) and (2). A constant was included but not reported. The coefficients are averages over 200 simulations and standard deviations across the 200 simulations are reported in parentheses. The simulated data are calibrated to match long-run trends in the aggregate U.S. economy and state-level output data. The data are simulated for T=100 "years." The left-hand side is the logarithm of the ratio of GDP to GNI averaged over years T–19 to T and "Log Average Output" is the logarithm of the level of GDP averaged over years T–23 to T–19. "Ownership Share T–61 to T–51 " is the logarithm of the share of ownership of the aggregate capital stock averaged over years T–61 to T–51. See the text for parameter values.

Table 3: **Descriptive Statistics by State**

|  | Avg. Dividend Inc. 1939−1949 | Avg. Interest Inc. 1939−1949 | GSP Growth 1980−1990 | Avg. GSP 1977−1980 | Avg. Out/Inc 1981−2000 |
|---|---|---|---|---|---|
| Alabama | 91.54 | 163.34 | 19.22 | 20,201 | 0.98 |
| Alaska | . | . | −46.04 | 63,426 | 1.63 |
| Arizona | 182.46 | 300.29 | 3.76 | 23,502 | 0.97 |
| Arkansas | 64.18 | 137.50 | 17.72 | 19,450 | 0.97 |
| California | 451.10 | 561.99 | 15.97 | 29,642 | 1.02 |
| Colorado | 301.04 | 437.14 | 7.11 | 27,640 | 1.00 |
| Connecticut | 881.53 | 778.44 | 34.43 | 27,657 | 0.96 |
| Delaware | 1846.49 | 860.02 | 40.49 | 28,380 | 1.21 |
| Florida | 404.19 | 405.22 | 16.96 | 21,852 | 0.88 |
| Georgia | 173.98 | 189.98 | 26.46 | 22,624 | 1.07 |
| Hawaii | . | . | 26.50 | 29,492 | 1.06 |
| Idaho | 85.37 | 269.30 | 4.65 | 22,958 | 0.97 |
| Illinois | 421.06 | 498.47 | 15.41 | 28,595 | 0.99 |
| Indiana | 214.20 | 305.85 | 14.57 | 24,489 | 0.98 |
| Iowa | 164.52 | 347.55 | 6.66 | 25,988 | 0.98 |
| Kansas | 115.39 | 299.11 | 9.14 | 25,432 | 0.97 |
| Kentucky | 163.19 | 191.12 | 13.99 | 22,493 | 1.03 |
| Louisiana | 155.54 | 221.39 | −10.47 | 29,678 | 1.23 |
| Maine | 394.94 | 516.45 | 24.53 | 19,435 | 0.93 |
| Maryland | 472.86 | 568.16 | 26.80 | 24,143 | 0.88 |
| Massachusetts | 629.07 | 675.06 | 31.38 | 25,099 | 0.99 |
| Michigan | 307.69 | 410.73 | 11.75 | 26,361 | 0.95 |
| Minnesota | 248.94 | 380.58 | 15.16 | 26,416 | 0.99 |
| Mississippi | 58.18 | 121.50 | 12.04 | 18,594 | 1.00 |
| Missouri | 321.69 | 379.03 | 16.96 | 24,479 | 0.99 |
| Montana | 197.74 | 342.49 | −8.18 | 24,322 | 0.94 |
| Nebraska | 171.21 | 337.71 | 16.69 | 25,194 | 1.01 |

## Descriptive Statistics by State—continued

|  | Avg. Dividend Inc. 1939−1949 | Avg. Interest Inc. 1939−1949 | GSP Growth 1980−1990 | Avg. GSP 1977−1980 | Avg. Out/Inc 1981−2000 |
|---|---|---|---|---|---|
| Nevada | 534.41 | 549.99 | 5.48 | 32,226 | 1.07 |
| New Hampshire | 437.30 | 533.42 | 28.75 | 21,558 | 0.93 |
| New Jersey | 466.87 | 600.63 | 34.77 | 26,183 | 0.95 |
| New Mexico | 179.61 | 225.41 | −2.99 | 25,088 | 1.13 |
| New York | 726.88 | 908.47 | 23.34 | 28,652 | 1.02 |
| North Carolina | 153.86 | 152.73 | 26.11 | 22,269 | 1.05 |
| North Dakota | 72.11 | 252.14 | −5.13 | 25,003 | 1.01 |
| Ohio | 374.76 | 398.71 | 12.95 | 25,670 | 0.98 |
| Oklahoma | 150.98 | 223.83 | −8.52 | 24,848 | 0.99 |
| Oregon | 214.83 | 432.19 | 7.31 | 26,098 | 0.97 |
| Pennsylvania | 423.30 | 477.04 | 17.89 | 24,161 | 0.92 |
| Rhode Island | 583.55 | 598.69 | 23.96 | 21,802 | 0.92 |
| South Carolina | 90.14 | 155.05 | 26.03 | 19,560 | 1.00 |
| South Dakota | 105.65 | 239.10 | 21.06 | 21,935 | 1.01 |
| Tennessee | 137.32 | 189.95 | 23.17 | 21,786 | 1.02 |
| Texas | 171.05 | 265.15 | −3.12 | 29,488 | 1.12 |
| Utah | 175.30 | 287.17 | 8.38 | 22,802 | 1.04 |
| Vermont | 328.35 | 473.06 | 26.39 | 20,370 | 0.96 |
| Virginia | 230.20 | 235.47 | 27.16 | 24,191 | 0.99 |
| Washington | 232.67 | 431.22 | 16.38 | 27,577 | 0.99 |
| West Virginia | 173.37 | 186.22 | 0.95 | 21,599 | 0.94 |
| Wisconsin | 269.22 | 438.38 | 12.12 | 25,166 | 0.97 |
| Wyoming | 226.85 | 400.49 | −24.22 | 43,191 | 1.37 |

*Notes:* Avg. Dividend Inc. 1939−1949 and Avg. Interest Inc. 1939−1949 are, respectively, dividend and interest income per capita in 2000 prices, averaged over 1939−1949. GSP growth 1980−1990 is the growth rate of GSP per capita, from 1980 to 1990. Avg. GSP 1977−1980 is GSP per capita in 2000 prices, averaged over 1977−1980. Average Out/Inc 1981−2000 is output divided by income (and normalized by U.S. output/income), where output is Gross State Product (GSP) and income is State Personal Income (SPI), averaged over 1981−2000.

Table 4: **Descriptive Statistics**

|  | Mean | S.D. | Max. | Min. |
|---|---|---|---|---|
| Avg. Output/Income 1981−2000 | 1.02 | 0.12 | 1.63 | 0.88 |
| Avg. GSP 1977−1980 ($1,000 per capita) | 25.8 | 6.80 | 63.4 | 18.6 |
| Avg. Div&Int Inc. 1939−1949 ($1,000 per capita) | 0.69 | 0.46 | 2.70 | 0.18 |
| Avg. Oil Share 1977−1980 (percent) | 3.00 | 6.00 | 22.00 | 0.00 |
| Retirees/Population 1980 (percent) | 11.00 | 2.00 | 18.00 | 3.00 |
| Avg. Out/Inc 1991−2000 minus Avg. Out/Inc 1981−1990 | −0.01 | 0.11 | 0.16 | −0.61 |
| GSP Growth from 1980 to 1990 (percent) | 13.68 | 17.56 | 37.27 | −49.94 |
| Population Growth from 1980 to 1990 (percent) | 7.43 | 9.09 | 36.47 | −8.63 |
| Change in Retirees/Population (percent) | 2.40 | 1.14 | 6.23 | 1.08 |
| Avg. Output/Income 1981−1990 | 1.03 | 0.17 | 1.93 | 0.87 |

*Notes:* 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). Average Output/Income 1981−2000 is output divided by income (and normalized by U.S. output/income), where output is Gross State Product (GSP) and income is State Personal Income (SPI), averaged over 1981−2000. Average GSP 1977−1980 is GSP per capita in 2000 prices, averaged over 1977−1980. Average Div&Int Inc. 1939−1949 is the sum of dividend and interest income per capita in 2000 prices, averaged over 1939−1949. Average Oil Share 1977−1980 is the share of the oil and mineral extraction sectors in GSP by state, averaged over 1977−1980. Retirees/Population 1980 is the share of retirees in state population in 1980. Avg. Out/Inc 1991−2000 minus Avg. Out/Inc 1981−1990 is the average of the ratio over 1991−2000 minus the average of the ratio over 1981−1990. GSP Growth is the rate of GSP per capita growth from 1980 to 1990. Population Growth is the rate of growth of state population from 1980 to 1990. Change in Retirees/Population is the change in the number of retirees from 1980 to 1990 divided by average population over 1980–1990. Average Output/Income 1981−1990 is output divided by income (and normalized by U.S. output/income), where output is Gross State Product (GSP) and income is State Personal Income (SPI), averaged over 1981−1990.

Table 5: **Change in Net Capital Income Flows**

Dep. Var: Avg. Out/Inc 1991−2000 minus Avg. Out/Inc 1981−1990

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| States | 47 | 47 | 47 | 47 |
| GSP Growth from 1980 to 1990 | 0.30 (3.12) | 0.09 (1.81) | 0.08 (1.75) | 0.06 (1.29) |
| Output/Income 1981−1990 | – – | −0.42 (6.87) | −0.42 (7.59) | −0.43 (8.95) |
| Population Growth from 1980 to 1990 | – – | – – | 0.08 (1.83) | 0.17 (2.71) |
| Change in Retirees/Population from 1980 to 1990 | – – | – – | – – | −0.92 (1.39) |
| $R^2$ | 0.41 | 0.76 | 0.78 | 0.78 |

*Notes:* 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). Avg. Out/Inc 1991−2000 minus Avg. Out/Inc 1981−1990 is the average of the ratio over 1991−2000 minus the average of the ratio in 1981−1990. Output/Income 1981−1990 is the average of the ratio over 1981−1990. GSP Growth is the rate of growth of GSP per capita from 1980 to 1990. Population Growth is the rate of growth of state population from 1980 to 1990. Change in Retirees/Population is the change in the number of retirees from 1980 to 1990 divided by average population over 1980–1990. A constant is included in all specifications. Heteroskedasticity robust $t$-statistics in parentheses.

Table 6: **Change in Net Capital Income Flows: Panel Regressions**

Dep. Var: Change in Output/Income

|  | (1) | (2) | (3) |
|---|---|---|---|
| Sample | 1981−2000 | 1980−2000 | 1981−2000 |
| GSP Growth Lagged | 0.06 (1.29) | 0.15 (3.87) | 0.10 (2.12) |
| Output/Income Lagged | −0.43 (8.95) | −0.35 (12.33) | −0.32 (9.25) |
| Population Growth Lagged | 0.17 (2.71) | 0.10 (2.11) | 0.02 (0.32) |
| Change in Retirees/ Population, Lagged | −0.92 (1.39) | −0.54 (1.07) | 0.06 (0.10) |
| Interval length | 10 | 7 | 5 |
| Time Periods | 1 | 2 | 3 |
| Observations | 47 | 94 | 141 |
| $R^2$ | 0.78 | 0.73 | 0.60 |

*Notes:* 47 states used in all regressions (missing data for Alaska and Hawaii and the outlier Delaware is left out). In each column the definition of a period of the panel changes; it is an average over a time interval, denoted "Interval length." For example, in column (2) the time-interval in each period of the panel is 7 years; hence we have 2 periods covering 1987−2000 and a lagged period 1980–1986. The number of observations is 2*47=94. Change in Output/Income is the difference between the output/income ratio in the current period and the previous one. GSP Growth Lagged is the total growth of GSP per capita within the previous period; thus, in column (2) it is the total growth over 7 years. Output/Income Lagged is the value the output/income ratio in the previous period. Population Growth Lagged is the total growth of population in the previous period. Change in Retirees/Population is the change in the number of retirees divided by average population in the previous period. A constant is included in all specifications. Heteroskedasticity robust $t$-statistics in parentheses.

Table 7: **Net Capital Income Flows**

Dependent Variable: Log of Average Output/Income 1981−2000

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| States | 47 | 47 | 47 | 47 |
| Log Average GSP 1977−1980 | 0.29 (3.12) | 0.43 (5.93) | 0.29 (4.95) | 0.24 (4.41) |
| Log Average Div&Int Income 1939−1949 | – – | −0.09 (5.71) | −0.06 (3.97) | −0.05 (3.35) |
| Log Average Oil Share 1977−1980 | – – | – – | 0.56 (3.14) | 0.54 (3.47) |
| Log Retirees/Population 1980 | – – | – – | – – | −0.11 (2.72) |
| $R^2$ | 0.34 | 0.65 | 0.73 | 0.76 |

*Notes:* 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). Average Output/Income 1981−2000 is output divided by income (and normalized by U.S. output/income), where output is Gross State Product (GSP) and income is State Personal Income (SPI), averaged over 1981−2000. Average GSP 1977−1980 is GSP per capita in 2000 prices, averaged over 1977−1980. Average Div&Int Income 1939−1949 is the sum of dividend and interest income per capita in 2000 prices, averaged over 1939−1949. Average Oil Share 1977−1980 is the share of the oil and mineral extraction sectors in GSP by state, averaged over 1977−1980; this regressor is transformed to log(1+share) in order to dampen outliers and avoid zero observations. Retirees/Population 1980 is the share of retirees in state population in 1980. A constant is included in all specifications. Heteroskedasticity robust $t$-statistics in parentheses.

Table 8: **Net Capital Income Flows: Other Measures of Income**

Dependent Variable: Log of Average Output/Income 1981−2000

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent Var. | $\frac{Out}{Inc.I}$ | $\frac{Out}{Inc.II}$ | $\frac{Out}{Inc.III}$ | $\frac{Out}{Inc.IV}$ |
| Income measure | SPI | SPI–Fed.Tr. | SPI–Commut. | Approx. GNI |
| States | 47 | 47 | 47 | 47 |
| Log Average GSP 1977−1980 | 0.24 (4.41) | 0.20 (3.20) | 0.13 (2.76) | 0.15 (3.20) |
| Log Average Div&Int Income 1939−1949 | −0.05 (3.35) | −0.06 (3.97) | −0.02 (2.13) | −0.06 (4.23) |
| Log Average Oil Share 1977−1980 | 0.54 (3.47) | 0.65 (3.53) | 0.62 (4.43) | 0.52 (2.97) |
| Log Retirees/Population 1980 | −0.11 (2.72) | −0.04 (0.79) | −0.17 (5.44) | −0.06 (1.47) |
| $R^2$ | 0.76 | 0.72 | 0.78 | 0.69 |

*Notes:* 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). Average Output/Income 1981−2000 is output divided by income (and normalized by U.S. output/income), averaged over 1981−2000, where output is Gross State Product (GSP) and our income measure varies as follows. Column (1) uses SPI for income. Column (2) uses SPI–Federal Transfers for Income. Column (3) uses SPI–Adjustment for Residence for Income. The adjustment for residence is equal to the wage income earned by residents of state $i$ that work in other states (not $i$) minus the wage income earned by residents of other states (not $i$) that work in state $i$. The mean of this variable as a percent of SPI for the sample here (47 states) is 0.7 percent; the standard deviation is 3 percent; the maximum (Maryland) is 11.4 percent; the minimum (New York) is –3.8 percent. Column (4) uses an approximation to state-level GNI based on Asdrubali et al. (1996) (see data appendix for details). This variable is available till 1999 so all the variables in this column are re-defined accordingly. Average GSP 1977−1980 is GSP per capita in 2000 prices, averaged over 1977−1980. Average Div&Int Income 1939−1949 is the sum of dividend and interest income per capita in 2000 prices, averaged over 1939−1949. Average Oil Share 1977−1980 is the share of the oil and mineral extraction sectors in GSP by state, averaged over 1977−1980; this regressor is transformed to log(1+share) in order to dampen outliers and avoid zero observations. Retirees/Population 1980 is the share of retirees in state population in 1980. A constant is included in all specifications. Heteroskedasticity robust $t$-statistics in parentheses.