Productivity and Capital Flows: Evidence from U.S. States *

Sebnem Kalemli-Ozcan
University of Houston and NBER

Ariell Reshef
New York University

Bent E. Sørensen
University of Houston and CEPR

Oved Yosha

November 2005

Abstract

We study the determinants of net capital income flows within the United States where capital freely moves across state borders. We use a simple neoclassical model in which total factor productivity (TFP) varies across states and over time and capital ownership is perfectly diversified across state borders. Capital will flow to states that experience an increase in TFP resulting in net cross-state investment positions. Net ownership positions revert to zero over time in the absence of further TFP movements. States with increasing TFP pay net capital income to states with declining TFP relative to the U.S. average. While TFP cannot be directly observed, we can identify states with high TFP growth as states with high output growth. By comparing the level of state personal income to state gross product, we construct indicators of net capital income flows. We then examine empirically if net capital income flows between states corresponds to the predictions of the model and whether net capital positions tend to converge to zero. Our empirical findings indicate persistent net capital income flows across states, which are an order of magnitude larger than the equivalent counterparts across countries. Thus, our results imply that frictions associated with borders are likely to be the main explanation for "low" international capital flows.

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

*For help with the data, we thank Jeffrey Newman from the BEA, and especially Kathy Albetski from the BEA, and Edward Trevelyan from the Federal Programs Branch, Governments Division, at the U.S. Census Bureau. For helpful comments, we thank participants at CEPR-conferences at Modena and Sardinia, at presentations at Trinity College, University of Copenhagen, Indiana University, New York University, the Central Bank of Norway, University of North Carolina, North Carolina State University, Rice University, Stanford University, University of California at Davis, at the Globalization and Real Convergence Workshop at the CEU in Budapest, 2004 LACEA meetings in Costa Rica, 2005 AEA meetings in Philadelphia, Oved Yosha memorial conference in Tel Aviv, and the 2004 Midwest Economics Meetings in St. Louis. In particular, we thank Laura Bottazzi, Francesco Caselli, Jonathan Eaton, Boyan Jovanovic, Peter Klenow, Narayana Kocherlakota, Miklos Koren, Philip Lane, John Lapp, Gian Maria Milesi-Ferretti, Kevin O'Rourke, David Papell, and Julio Rotemberg. Oved Yosha died from cancer on August 7th, 2003. His much too early death leaves a void in our profession and in our hearts.

1 Introduction

Capital flows between countries are much smaller than predicted by standard neoclassical models. The manifestations of low capital flows are high correlations of saving and investment, low international risk sharing, and home bias in asset holdings.[1] Low capital flows (relative to theoretical benchmarks) may be due to inherent failures of the frictionless model or to frictions associated with national borders. Therefore, it is important to study the patterns of capital flows between U.S. states, which have a common language, similar institutions, a common currency, and no legal barriers to capital flows—features that typically do not hold across international borders. With fully integrated capital markets, individuals can borrow and lend capital freely across state borders and, further, insure themselves against state-specific risk by holding a geographically diversified portfolio of assets.[2]

We study the empirical predictions of a simple frictionless neoclassical model, in which capital income—but not labor income—is fully diversified between states and where total factor productivity (TFP) varies across states and over time. The model delivers predictions regarding the magnitude of capital flows into states that experience an increase in TFP, the resulting net capital *income* flows between states, and the speed at which net capital income flows decline in the absence of further relative TFP movements. Our model implies that a typical state should hold foreign capital in an amount of about 3 times GDP. At the country level, foreign asset and liability positions in the OECD has increased at a remarkable rate in the 1990s.[3] Nonetheless, almost all countries hold amounts of foreign assets below the level of GDP.[4] We find that our empirical results using U.S. states match the predictions of the model well. Consequently, frictions associated with national borders are likely to be a significant part of the explanation for "low" international capital flows.[5]

---

[1] See Feldstein and Horioka (1980), Obstfeld and Rogoff (2000); Backus, Kehoe, and Kydland (1992), Kalemli-Ozcan, Sørensen, and Yosha (2001); French and Poterba (1991), Tesar and Werner (1995), Sørensen, Wu, Zhu, and Yosha (2005).

[2] Consistent with the results of our paper, the Feldstein-Horioka puzzle does not seem to be present for regions within countries. See, for example, van Wincoop (2000) and Sinn (1992), who looks at U.S. States using data—available for 1953 and 1957—from Romans (1965).

[3] See Lane and Milesi-Ferretti (2001).

[4] Ireland is a notable exception, who in 2001 held foreign assets (bonds plus equity) in an amount roughly equal to 3 times GDP.

[5] Our paper also complements studies such as Asdrubali, Sørensen, and Yosha (1996): they find that state-level income is about 40 percent insured against output shocks, while we here find that this is consistent with capital

In related work on G-7 countries, Glick and Rogoff (1995) find gross investment reacting more strongly than current accounts to TFP movements, which is add odds with theory under the assumption of perfect capital mobility. Gruber (2000) finds no responsiveness of the current account to real growth rates for a panel of OECD countries during 1975–2000.

In the next section, we outline an open-economy neoclassical model with Cobb-Douglas production functions and constant saving rates where the level of TFP varies by state and over time. We interpret TFP very broadly to include taxes, insurance, cost of heating/cooling, transportation, endowments of oil or minerals, agglomeration benefits etc. It is reasonable to think of capital as all factors of production that rely on investments and TFP as capturing all other non-labor inputs in the production function.[6]

Although the model is stylized, its broader implications are likely to hold in more complicated settings. Therefore, we do not estimate the model structurally; rather, we examine whether the relevant qualitative implications—as well as the quantitative magnitudes—suggested by our model are matched by the data. We focus on the following implications: first, net capital income flows will decline for states that experience a relative increase in TFP and, second, net capital income flows will converge to zero in the absence of relative TFP movements.

State-level TFP and net capital flows between states are not observed. However, an increase in state-level TFP is associated with an increase in the gross state product (GSP) per capita, where GSP measures the gross (pre-depreciation) value of *output produced* physically within each state. In other words, states with relatively high TFP growth can be identified as states with relatively high output growth. In a closed economy, high output growth could, of course, be due to high capital accumulation but with free mobility of capital among states capital moves to states with high TFP independently of the distribution of saving.

Relative levels of TFP are likely to be very persistent with some states having relatively high output per capita for many decades. This is consistent with Glick and Rogoff (1995) who find high persistence of country-level TFPs. If TFP levels are persistent for decades then states with recent

income being fully diversified across states while labor income is not fully diversified. In the data, the distinction between labor income and capital income is less clear and corporations often smooth wages across separate production units [Budd and Slaughter (2000)] which contributes to interstate risk sharing. In this paper, we ignore such issues and examine how closely the simplest growth model with perfect capital mobility can explain the data.

[6]Investment in human capital that requires investment outlays should be considered "investment" while endowments of abilities should be considered contributions to TFP.

high growth can be identified as states with current high *levels* of output. We expect such states to pay net capital income to other states for two reasons: 1) If capital ownership is fully diversified, most of the capital installed in a particular state is owned by other states, and high productivity would then lead to net capital income payments to other states. 2) During the recent high growth period out-of-state capital moved into the state and other states now hold large net claims on the state.

A less likely scenario—for U.S. states—is the case where barriers prevented capital flows between states in the past but such barriers have become less severe recently. In this case, we might observe capital flowing to states that have low output due to low capital stocks and, therefore, relatively *low* levels of output could be associated with net capital payments to other states. Such "catching up" is usually the main explanation for convergence of output levels. We bring up the issue because such patterns are common in international data—for example, think of U.S. capital flows to India after 1991.[7]

If one could observe saving and investment data by state, the difference between the two series would be a measure of the state "current account" and hence capital flows. Unfortunately, the requisite data simply do not exist for the U.S. states.[8] Instead we look at net capital income payments, which can be estimated from the difference between income and output. According to our model, net capital income can result from net ownership positions or from state specific TFP-shocks if capital ownership is fully diversified. Our model implies that a positive TFP-shock in a state leads to outflows of capital income and, at the same time, a net inflow of capital. In the literature, net capital income flows have been used to infer past capital flows by Atkeson and Bayoumi (1993). They used this method for U.S. states to argue that there are large inter-regional net capital flows since 1965 within the U.S. leading to large and persistent net capital ownership positions and regional "current account" deficits and surpluses. At the country level, capital flows are usually directly observed, but Canova and Bertocchi (2002) similarly use output/income ratio to infer past net inflows of capital to former African colonies where the historical capital flows data

[7]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). These authors suggest that low human capital in the South was the cause of relatively low economic performance and capital seems to rapidly have moved South as productivity has caught up. Our empirical analysis incorporates the investigation of such productivity "catch-up."

[8]The exception is the calculations done by Romans (1965) for 1953 and 1957, which show large current account deficits and surpluses by state.

of interest are not observed.[9]

To calculate the size of net factor income flows across the U.S. states we need state-level GDP and state-level income. In the country-level national accounts, GDP plus net income receipts from abroad is denoted as Gross National Income (GNI). The U.S. state-level "national" accounts do not include GNI or net factor income flows, but we can construct approximations to GNI which help us trace net capital income flows. We use State Personal Income (SPI) as our base approximation to state-level GNI in our empirical work. The main difference between SPI and a more comprehensive measure of income comparable to GNI are contributions to social insurance less transfer payments, corporate retained earnings, and indirect taxes, all of which we impute in the robustness section. Personal dividend, interest, and rental income is available by state, but we prefer to use SPI. Properly measured state-level GNI should include large amounts of earnings from other states and such income may well not be captured by personal dividend income. Dividend income may miss entitlement income that are not directly measured such as bonuses, pensions, etc., paid in one state from company earnings in other states. Personal dividend income constitutes about 5 percent of total personal income—a fraction much lower than the share α (typically 0.33) of output accruing to capital according to the model. Therefore, such data may underestimate actual net capital flows.[10]

The implications of our model can be tested by estimating two sets of regressions. The first set of regressions examines the relationship between the *change* in the output/income ratio—our measure of the change in net capital income payments—and past output growth—an indicator of TFP *change*.[11] The second set of regressions examines whether the *level* of the output/income ratio is relatively high for states with high *levels* of output. The model predicts a positive relationship

[9] For the (aggregate) U.S., current account surpluses went hand-in-hand with positive net factor income from abroad (equivalent to income being higher than output) for most of the previous century. In the mid-1980s, the U.S. current account turned negative and net factor income from abroad fell sharply. (U.S. net factor payments to other countries are still fairly low because many central banks hold low-interest reserve assets.) This pattern is not surprising, but it confirms that when current accounts and net factor income are both directly observed, net factor income reflects past current accounts.

[10] If a large oil company is based in Texas and earns profits based on an increase in oil extraction in Alaska, we observe an increase in the output of Alaska, while capital income increases in states where the stock holders of the oil company live. Of course, part of a corporation's profits may be used to pay salaries and bonuses to employees and management at the headquarters. The latter type of factor income may be an important part of interstate factor income. We do not explore this issue in further detail and in this paper we interpret all net factor income as "net capital income."

[11] Using *lagged* growth as the right-hand side variable in the regression has the further benefit of alleviating potential endogeneity problems.

between these variables for both sets of regressions.

The "change regressions" show that states with relatively high growth in the 1980s experienced an increase in the output/income ratio in the 1990s of an order of magnitude consistent with the model's predictions. Also, as predicted by the model, the output/income ratio converges to unity over time when the relative TFP movements are controlled for. In the "level regressions," the output level is also a significant predictor for the level of the output/income ratio with the predicted positive coefficient. In other words, capital seems to flow from poor to rich states, similarly to what is often observed at the country level where capital often flows from poor to rich countries, where rich countries are the ones with high TFP growth.[12]

In the next section, we derive the predicted ratio of output to income in the framework of a stylized model. Section 3 discusses our data and, in section 4, we perform the empirical analysis. Section 5 presents the robustness analysis and section 6 concludes the paper.

2 Capital Flows in a Neoclassical Model

In this section, we outline a simple open-economy growth model in order to highlight how the ratio of GDP to GNI can be expected to vary with states' (historical) asset holdings and with state-level TFP. The purpose of the model is to draw out empirical implications to be examined in our empirical work. In our model, the ex ante rate of return to investment is same across all states;[13] i.e., we ignore risk premiums.[14]

[12]In international samples where capital flows may recently have been liberalized, capital may flow to countries with low capital ("K"). Since low capital countries also are low output countries this would be revealed as a negative coefficient when regressing the output/income ratio on the level of output. The finding of a positive coefficient (in a regression of capital flows on GDP per capita) at the country level is regarded as a "paradox" because it contradicts the open-economy Solow model with integrated capital markets and constant TFP as shown by Lucas (1990). A large literature addresses the issue of what determines capital flows between countries. Some of the "usual suspects" are explicit barriers to investment, bad institutions (corruption, rule of law,..), and sovereign risk; see, for example Alfaro, Kalemli-Ozcan, and Volosovych (2003) and Reinhart and Rogoff (2004). These determinants of capital flows can be interpreted as indicators of TFP differences. In this paper, we only make limited attempts to sort out what explains differences in TFP across states, partly because we do not directly observe capital stocks and therefore TFP.

[13]In reality, TFP levels are not fully predictable and, as a first approximation, we assume that *a priori* expected real returns are equal across states. If TFP in state i is higher than expected in a given period, relative to other states, this will increase output while income in state i will increase less, because it is partly derived from other states. In other words, *ex post* positive TFP shocks in state i will lead to increases in the output/income ratio.

[14]One might imagine that a state with a very specialized output structure such as Wyoming might be paying a risk premium on its liabilities. In terms of our model of capital flows, this would be equivalent to a lower *level* of capital flowing into Wyoming relative to the situation with no risk premiums. (Capital would flow until the expected marginal return on capital equals the safe U.S.-wide interest rate *plus* the risk premium.) However, the *direction*

Consider N states, indexed by i (for now, we suppress the time index t) each having a simple Cobb-Douglas production function. In what follows, the allocation of capital across states is determined by TFP, i.e., A_i.[15] In order to stress that the allocation of capital is a function of relative levels of TFP, we write the production function as

$$GDP_i = A_i K_i(A_i)^{\alpha} L_i^{1-\alpha} \ . \tag{1}$$

For simplicity, we consider the case where labor is immobile and each state has the same amount of labor $L_i = \frac{1}{N}L$, where L is aggregate labor. Assume that capital flows freely across states.[16] The aggregate U.S. capital stock is K. K is aggregate capital *installed* but, because we consider the United States to be a closed economy, we can also think of K as being a nationwide mutual fund; i.e., as capital *owned*. The assumption that the United States is a closed economy is obviously wrong. This simplification is, however, only made in order to simplify derivations. It does not affect our empirical results since our regressions control for aggregate U.S.-wide effects.[17] State i owns a share ϕ_i in the mutual fund implying that the amount of capital *owned* by state i is $\phi_i K$. Of course, $\Sigma\phi_i = 1$. We assume ϕ_i is positive for all states which implies that the residents of each state own *some* capital, whether it is installed in their home state or in other states. K_i is capital *installed* in state i and $K = \Sigma K_i$. We assume no frictions, so capital flows to state i until

$$R = \alpha A_i K_i^{\alpha-1} L_i^{1-\alpha} \ , \quad \forall i \tag{2}$$

of flows would not be reversed and the magnitude of capital flows in response to TFP shocks would likely not be strongly affected by risk premiums even if the overall *level* of capital flowing to Wyoming would be lower.

[15]We do not study country-level data in any detail in this paper, but 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 the first to the last half of this sample also are positively correlated. The correlations are 0.21 and 0.37, respectively. While these correlations do not prove causality they confirm that, as a minimum, country-level TFP and capital invested are positively correlated in data where capital data is directly observable.

[16]In the empirical part of the paper, we consider averages over decades in order to avoid issues related to adjustment of capital and we consider the effect of migration. The predictions of our model hold as long as the systematic net migration across states in *response* to productivity shocks is significantly lower than the mobility of physical capital. 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 modelled as malleable capital when long time intervals are considered.

[17]If investment in, say, California is financed by Japanese savings, the output/income ratio of California is above unity and our regression analysis will give the correct results because we control for aggregate effects such that our results are determined only by relative output/income ratios. (The results may be slightly weaker in the case of foreign investments because the income from investment in a state then will not decrease the output/income ratio in other states as it otherwise would.)

where R is the equilibrium gross rate of interest. The gross income of the U.S. mutual fund is RK and the wage rate in state i is $w_i = (1-\alpha)A_i K_i^{\alpha} L_i^{-\alpha}$. GNI in state i is, therefore,

$$GNI_i = \phi_i\, RK + w_i L_i = \phi_i\, RK + (1-\alpha)A_i K_i^{\alpha} L_i^{1-\alpha} \ , \tag{3}$$

and the GDP/GNI ratio is

$$\frac{GDP_i}{GNI_i} = \frac{A_i K_i^{\alpha} L_i^{1-\alpha}}{\phi_i\, RK + (1-\alpha)A_i K_i^{\alpha} L_i^{1-\alpha}} \ . \tag{4}$$

In order to illustrate the partial effect of varying ownership shares and the partial effect of varying productivity, we consider these cases one-by-one.

2.1 The Ratio of GDP to GNI as a Function of Ownership

We start by examining the case of state-varying ownership shares and assume A_i constant (=1 for simplicity) across states. In this case, installed capital K_i is identical for each state i and equal to $K_i = K/N$, i.e., *installed* capital is spread out evenly across states. Then aggregate $GDP = NGDP_i$ and $RK = RNK_i = N\alpha GDP_i$. Therefore,

$$\frac{GDP_i}{GNI_i} = \frac{K_i^{\alpha} L_i^{1-\alpha}}{\phi_i\, N\alpha\, GDP_i + (1-\alpha)K_i^{\alpha} L_i^{1-\alpha}} = \frac{1}{N\phi_i\alpha + (1-\alpha)} = \frac{1}{1 + (N\phi_i - 1)\alpha} \ . \tag{5}$$

This number is smaller than one for states with above average ownership ($\phi_i > 1/N$) and vice versa for states with below average ownership shares.

It is simple to demonstrate that in the absence of productivity shocks the ratio of GDP to GNI reverts to 1 assuming that the saving rate is constant across states and the same for capital and labor income. The logic is that, wage income is the same in all states when productivity levels are similar, and because a fraction $1-\alpha$ of saving is derived from labor income the overall ownership fraction of each state will slowly revert to the average value of 1. In order to get a quantitative impression of the speed with which mean reversion takes place, we performed a simulation of two states which initially have different ownership shares. We focus on one of the states for which GDP/GNI takes an arbitrary value above 1 in the initial period. With $\alpha = 0.33$, a saving rate of 15 percent, and a depreciation rate of 5 percent, the model implies a half-life of about 15 years for the deviation of the GDP to GNI ratio from 1.

This calculation ignores forward looking savings behavior. According to permanent income theory, individuals save a smaller fraction of their income the higher the expected present value of current income shocks. Thus, the saving rate and output/income ratio may depend on the time series properties of income shocks. The broad empirical predictions of the model are not likely change much due to this and we, therefore, abstain from complicating the model further along this dimension.[18]

2.2 The Ratio of GDP to GNI as a Function of Productivity

Consider now the case where all ownership shares are identical ($= 1/N$) but TFP varies across states. We still assume that the labor endowment is constant and identical for each state. For $\phi_i = 1/N$ the GDP/GNI ratio is

$$GDP_i/GNI_i = \frac{A_i(K_i^{\alpha} L_i^{1-\alpha})}{\frac{1}{N} R\,K + (1-\alpha) A_i K_i^{\alpha} L_i^{(1-\alpha)}} \ , \tag{6}$$

We assume N large so the effect of state i productivity on U.S. aggregate output can be ignored. We have $RK = \alpha GDP$ since all states a identical except state i which is small. Then,

$$GDP_i/GNI_i = \frac{GDP_i}{\alpha GDP/N + (1-\alpha)\,GDP_i} = \frac{1}{\alpha \frac{GDP/N}{GDP_i} + (1-\alpha)}. \tag{7}$$

From equation (7), it is clear that the model implies, *given ownership shares*, that a higher level of output relative to the average is associated with a higher output/income ratio.

If initial $GNI_i = GDP_i$, and if state i experience a productivity shock while aggregate output

[18]Income is composed of capital income and labor income. If an increase in TFP signals future increases in TFP, residents of a state with strong current TFP growth might expect higher future labor income growth and therefore save less. (Only the relative, "state specific," patterns will matter in our regressions.) This will in turn cause a higher future output/income ratio. We cannot, a priori, rule out the possibility that part of the positive relationship we find between past growth and the output/income ratio is due to this effect. However, this effect is not likely to be large because the evidence shows that current state-specific income growth only *weakly* predicts future state-specific income growth, see Ostergaard, Sørensen, and Yosha (2002). (Of course, consumers may use a larger information set in order to predict future income but it is not clear how we could obtain useful empirical data on this issue. In any event, if capital income is fully diversified there will be no state-specific shocks to capital income so any effect would come only from labor income. Therefore, the direction of capital flows would still be in the direction suggested by the model with a fixed saving rate.

is unchanged, we find from total differentiation of (7) that

$$\frac{d(GDP_i/GNI_i)}{dA_i} =$$

$$\frac{\alpha K_i^\alpha L_i^{1-\alpha} + \alpha^2 A_i K_i^{\alpha-1} L_i^{1-\alpha} dK_i/dA_i}{GNI_i} \;.$$

Since $dGDP_i = (K_i^\alpha L_i^{1-\alpha} + A_i \alpha K_i^{\alpha-1} L_i^{1-\alpha} dK_i/dA_i) dA_i$ we get the testable implication;

$$d(\frac{GDP_i}{GNI_i}) = \alpha \,\frac{dGDP_i}{GDP_i} \tag{8}$$

which states that the change in the output/income ratio should be proportional to the percentage change in GDP. Because we derived this relation assuming constant aggregate productivity, the empirical implication is that the relation should hold when we control for aggregate variables.[19]

2.3 The Ratio of GDP to GNI as a Function of Ownership and Productivity

Finally we derive the expression for the output/income ratio in the case where both the ownership share and the productivity level deviates from the aggregate. For (small) state i, total capital income is $RK \;=\; \alpha A K^\alpha L^{1-\alpha}$. Since $L_i = L/N$, we have

$$\frac{GDP_i}{GNI_i} = \frac{A_i K_i^\alpha}{\phi_i N \, \alpha A (K/N)^\alpha + (1-\alpha) A_i K_i^\alpha} \;, \tag{9}$$

from which we can observe that the output/income ratio is larger the smaller $\phi_i N$ and the larger A_i.

From equation (2) we have $R \;=\; \alpha A_i K_i^{\alpha-1} L_i^{1-\alpha}$ which implies

$$K_i \;=\; L_i (\frac{\alpha A_i}{R})^{\frac{1}{1-\alpha}} \tag{10}$$

Given $L_i = L/N$

$$\frac{K_i}{K_j} = (\frac{A_i}{A_j})^{\frac{1}{1-\alpha}} \;, \tag{11}$$

[19] A state like California is obviously not negligible but even for a state that produce 10 percent of U.S. output the effect will, as a first approximation, be to lower the impact of growth from α to 0.9α. We do not account for this in the model since the magnitude of the average downward bias from this is minor.

We assume that all states $j \neq i$ have $A_j = A$ and state j is negligible in the total. Then $K_j = K/N$, which implies $K_i = K/N * (\frac{A_i}{A})^{\frac{1}{1-\alpha}}$.

If there is no *net* capital mobility, $K_i = K/N$ and $\phi_i = 1/N$, and equation (9) becomes,

$$\frac{GDP_i}{GNI_i} = \frac{A_i}{\alpha A + (1-\alpha)A_i} \tag{12}$$

However, under full mobility of capital we have, $K_i = K/N * (\frac{A_i}{A})^{\frac{1}{1-\alpha}}$, thus the equation (9) becomes,

$$\frac{GDP_i}{GNI_i} = \frac{A_i(\frac{A_i}{A}^{\frac{1}{1-\alpha}}K)^\alpha}{\phi_i N\, \alpha A K^\alpha + (1-\alpha)A_i(\frac{A_i}{A}^{\frac{1}{1-\alpha}}K)^\alpha} = \frac{A_i^{\frac{1}{1-\alpha}}}{\phi_i N\, \alpha A^{\frac{1}{1-\alpha}} + (1-\alpha)A_i^{\frac{1}{1-\alpha}}}\ , \tag{13}$$

A comparison of equations (12) and (13) reveals how the effect of an increase in productivity on the output/income will be amplified by the inflow of capital in response to the higher level of productivity.

Our model clearly ignores many features of reality and it is important to keep the goal of our paper in mind. We aim to show that the simplest neoclassical model, where capital is attracted to high productivity states, is able to predict patterns of net capital income flows across U.S. states. The empirical predictions are: 1) a change in output is followed by a change in the output/income ratio of about α times the growth in GDP, 2) the output/income ratio reverts to its mean of one with a half-life of about 15 years, 3) an increase in productivity increases the output/income ratio for given net asset holdings, and 4) for given productivity an increase in net asset holdings lowers the output/income ratio.

3 Data

We use data from the Bureau of Economic Analysis (BEA) unless otherwise stated. All nominal variables are converted into 2000 prices using the Consumer Price Index.[20]

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

[20]See the data appendix for the detailed description of the variables.

industries in the state, thus, it is exactly the state-level equivalent of GDP.[21] GSP is available for the years 1977–2000.[22]

Our main measure for income is state-level personal income (SPI), which is available from the BEA. For easy reference, we show the relation of GNI to GDP in the aggregate U.S. "National Income and Product Accounts (NIPA)" in appendix A. As argued in the introduction, the main differences between GNI and SPI are due to (gross) corporate saving (included in GNI but not in personal income) and government transfers (included in personal income but not in GNI).

One 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. Another simple modification is to adjust the SPI data for cross-state commuter's income. We are able to do so by using "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. The final modification, which is the closest approximation to "state-level GNI" is to calculate "state income," which is the income 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.[23] "State income" plus retained corporate earnings can be considered an approximation to GNI. Retained corporate earnings are not available by state and we impute the state-level numbers from aggregate data.[24]

[21] More precisely, GSP is the value of goods and services produced less net purchases of factors of production and intermediate goods and services from other states. BEA measures actual shipments and physical production. See Beemiller and Downey (2001).

[22] Previously published, but no longer updated by the BEA, GSP is available since 1963, but that data is less reliable.

[23] 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.

[24] We allocate aggregate retained earnings to states by allocating each state a share which corresponds to the share of that state in total personal dividend income. By imputing aggregate corporate retained earnings to states using fixed weights (the share in personal dividend income) we might be biasing our results towards finding a positive relation between past growth and current output/income ratio. This could happen if corporate earnings in high growth states belong to residents of such states due to preferences for investing locally ("home bias"). (We owe this

Another approach is to use direct estimates of net external assets for U.S. states 1971–2001 imputed by Duczynski (2000)—his net asset estimates are, to a large extent, based on different data from our's, so they are quite independent of our approximations to GNI.

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. We also use Duczynski's asset variables to a limited extent, which are based on personal dividend, interest, and rental income, and thus may miss entitlement income as discussed in the introduction. Nevertheless our robustness section shows results using all of these adjusted series for income.

4 Empirical Analysis

4.1 The Output/Income Ratio

The output/income ratio is our measure of the relative magnitude of net inter-state capital income flows to a state. If such flows are zero, the ratio is unity; if they are negative, the ratio exceeds unity; and if they are positive, the ratio is less than unity. We calculate this 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 affecting 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 use the normalized output/income ratio:

$$\text{OUT/INC}_{it} = \frac{\text{GSP}_{it} \,/\, \text{SPI}_{it}}{\text{GSP}_t \,/\, \text{SPI}_t}\,, \tag{14}$$

where:

$$\text{SPI}_t = \Sigma_i \, \text{SPI}_{it} \quad , \quad \text{GSP}_t = \Sigma_i \, \text{GSP}_{it}\,. \tag{15}$$

observation to Julio Rotemberg.) However, Coval and Moskovitz (1999) find that local home bias within the U.S. is not that big: the tendency to invest locally is there, but they find that only 20 percent of investors' portfolio is biased towards local securities. We also checked the ratio of imputed corporate retained earnings to state personal income both for levels (10 year average) and changes (from decade to decade). This is a small number; around 0.03-0.04 for most of the states.

The ratio OUT/INC_{it} captures state i's output/income ratio in year t relative to the aggregate output/income ratio of the U.S. states.

4.2 State "Current Accounts:" Estimates from Romans (1965)

In table 1, we display state-level "current accounts" (with the sign reversed) for U.S. states for 1953 and 1957 (the only years available)—more precisely, we display investment *minus* saving for these years as estimated by Romans (1965).[25] Those numbers clearly show that investment *minus* saving was very large for southern states as well as for oil states, which we consider in detail shortly. It is clear that during this period capital was flowing from the north and west to oil-rich states such as Texas and Louisiana, as well as to states in the old south, such as Mississippi and Alabama, which were in the process of catching up. The states with high values of investment minus saving in the 1950s tend to be the states with high output/income ratios in the 1980s and 1990s.

We examine directly if the output/income ratio captures past "current accounts" by regressing the output/income ratio averaged over 1963-70 on the average of "current accounts" from Romans for the years 1953 and 1957 (averaging may reduce measurement error). The results of this regression are displayed in the first column of table 2. We find a highly significant value of the coefficient to the past "current account" with an R^2 of 0.51. Clearly, there is a strong relationship between the output/income ratio and the "current account" ten years earlier. In columns 2–4, we display the results for similar regressions for the decades of the 1970s, 1980s, and 1990s. We observe a decline in the explanatory power as we consider more recent decades but the "current account" from the mid 1950s is still a significant determinant of the output/income ratio in the 1990s with an R^2 of 0.19. Of course, the declining R^2 for more recent decades is fully consistent with our model, which predict that the output/income ratio tends to revert to unity. Overall, the results using Romans' data provide a strong piece of evidence supporting the notion that the output/income ratio trace past net capital flows.

[25]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.

4.3 Graphical Evidence: 1963–2000

Figure 1 shows the output/income ratio and the growth rates for eight U.S. Census regions (we aggregate to regions in order to get less cluttered plots). The "big picture" that emerges, apart from the common growth slow-down in the 1980s, is one where the Southeast had relatively high growth in the 1960s while the Great Lakes and New England 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.[26] 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 which saw a steady decrease in the ratio throughout the 1960s and 1970s moving from above to below average.[27] Another significant change is the decline in the output/income ratio for the Southwest at the same time as the output/income ratio increases 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 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 (at the time referred to as the "Massachusetts miracle") and, therefore, the output/income ratio of New England should have been rapidly increasing. And that is exactly what is borne out by the data. The pattern for the Southeast is pretty much the inverse of that found for New England and, again, consistent with our model.

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

[26] See North (1961).

[27] 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.

stayed below unity. This is consistent with our model when net capital flows are large: New England was a net supplier of capital to other states in the 1950s (and, likely, 1960s) and therefore a net creditor at the beginning of the 1980s and, therefore, the output/income ratio stays below unity as predicted by equation (13)—but not by equation (12) which shows the predicted output/income ratio with full diversification but no net capital flows.

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.[28] There is a clear observable pattern with the output/income ratio of these states increasing following (with about a year's lag) steep increases in the price of oil and *vice versa*. This pattern is fully consistent with oil exploration having been financed by other states which in periods of high oil prices receive relatively higher factor income from those oil states.

The very steep changes in the output/income ratio for the oil-states in the 1980s likely reflects very high returns to capital due the high prices of oil ("productivity shocks" in our model). Therefore, it may be tenuous to directly identify the output/income ratio with net ownership positions, especially in periods of rapidly changing relative prices, during which differential returns to capital may be the driving force.

4.4 Specification of Regressions

In order to test the implications of our model, we estimate two sets of regressions: first, we regress the *change* in the output/income ratio on *growth*. More precisely, we average the output/income ratio over the 1990s and over the 1980s and calculate the change. We then regress the change in the output/income ratio from the 1980s to the 1990s on the growth rates of GSP per capita in the 1980s. (The regressor is the total growth over the decade 1981–1990.) The model predicts a positive coefficient. We also include the level of the output/income ratio in the 1980s. The model

[28]Oil prices are from the Energy Information Administration in the U.S. Department of Energy.

predicts that, conditional on growth, the output/income ratio converges and we therefore expect a negative coefficient.

Second, we fit "level regressions," where we regress the output/income ratio on the *level* of output. We avoid using GSP data for exactly the same sample as we use for the output/income ratio for the simple reason that GSP is used in the numerator of this ratio. If GSP is measured with error, such measurement error would lead to a spurious positive correlation of GSP with the output/income ratio. Therefore, we use the logarithm of per capita GSP averaged over the four years (1977–1980) prior to the years used for measuring the output/income ratio (1980–2000). The averaging removes most short-term business cycle effects which, for the purpose of this paper, are equivalent to measurement error.

4.5 Additional Control Variables

Agglomeration

If agglomeration determines TFP then capital will flow to states where there are agglomeration benefits. TFP increases will probably cause an increase in the output/income ratio even in more complicated versions of the model so potential indicators of TFP increases, such as agglomeration, may lead to an increase in the output/income ratio beyond that explained by the GDP growth-rate. Urbanization may affect TFP if agglomeration benefits are important. Therefore, we add the share of urban population in total population in 1980 as a regressor.

Historical Wealth

Our model predicts that ownership patterns persist for decades. In order to examine if ownership patterns persist over longer time spans, we examine if historical wealth predicts current output/income ratios. As our measure of historical wealth, we use the logarithm of per capita average (over 1939–1949) value of dividend and interest income by state.[29] 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, but in order to avoid the financial upheavals of the great depression, we chose the 1939–49 sample. The results are not very sensitive to exactly which sample is chosen,

[29] The historical dividend and interest income data is made available to us by the BEA. The BEA publish the sum of dividend, interest, and rent income, together with other income data, since 1929. We prefer to use data that does not include rental income, because this type of income is typically due to locally used and owned property.

except that the coefficient to this variable is smaller if we use the data from the 1930s.[30]

Geography

Historically, the northern states were the seat of U.S. industrialization and much wealthier than the south. We define a dummy variable, which takes the value 1 for New England, Mid-East, and Great Lakes and 0 for other regions.[31]

Sectoral Shares

Oil is a natural resource that typically demands capital for its exploration and extraction. The location of oil extraction is highly concentrated in relatively few states that likely obtain a large fraction of the required capital from outside sources (most clearly observed in Alaska where the large multinational oil companies have made large investments). As such investments are amortized the output/income ratio of oil states would be expected to be larger than unity. We do not observe the actual natural endowment of oil and minerals, so we approximate it by the share of the oil and mineral extraction sector in total GSP. We take the average over 1977–80.[32]

Historically, agricultural areas have often been laggards in terms of TFP growth, but this may not be true in recent periods for the U.S. It is also the case that farms typically have relied little on foreign capital, although this seems to be changing: large farms in parts of the country are highly capital intensive and it is possible that part of this capital has been financed from other states, although only recently has the farming sector seen major trends towards a corporate structure (see Drabenstott 1999). We include the share of agriculture in GSP in the same way (and for the same sample) as for the oil and mineral extraction share in GSP. We further include the share of manufacturing in GSP. In order to dampen the impact of outliers, we use the transformation $\log(1+x)$ for all the endowment variables

[30]We obtain similar results if we leave out the World War II period. One reason might be that dividends were still paid out during the war years.

[31]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 in figure 1.

[32]Oil price shocks and other changes in relative prices are not explicitly part of our model; however, an increase in oil prices in the data will correspond to a positive TFP shock in the model for an oil state. Again, it is possible that such effects are not completely captured by the GDP growth rate in our regressions.

Migration of Young and Old

Our model does not allow for differences in age of population, but if life cycle saving affects the patterns of net capital flows, then states with a relatively high number of retirees would have higher income relative to output because retirees typically contribute little to output but nevertheless have income from retirement savings. We use the share of residents aged 65 and above in the population of each state in 1980 as a regressor in order to examine potential impacts of life-cycle saving.

If homogenous labor migrated as fast as capital, we should not expect to find any patterns in our per capita data because a productivity shock would lead to an inflow of both labor and capital until wages and returns to capital were identical across regions. Migration seems to respond to relative prosperity, but not very fast, see Barro and Sala-i-Martin (1995).[33] A more serious concern is migration of non-homogeneous labor. Migration seems partly to be made up of retirees moving to the sun-belt states, but such patterns should be captured by the inclusion of number of retirees as a regressor. Migration for work, on the other hand, seems mostly to be made up of young workers. If such workers have low life cycle savings, we should expect net in-migration to lead to a higher ratio of output to income (when the share of retirees has been controlled for). We add as a regressor the rate of net inter-state migration as a percent of state population in 1975−1980.[34]

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. Alternatively, high human capital may be correlated with a high level of TFP and again we would expect that human capital would be correlated with a high output/income ratio. We control for human capital, which is measured as the number of college graduates in a state relative to population in 1989.[35]

[33] They find that a 10 percent positive differential in income per capita raises net-in-migration at a rate corresponding to an increase in population growth of 0.26 percent per year.

[34] Net overall migration is the sum of three components: 1) net inter-state migration (into each state), 2) net international migration, and 3) net number of federal employees moving in and out of US. For 1975−1980 only the first component is available. For the later years all three components are available. Our results are virtually identical, whether we use the first component or the sum of all components for the years where they are all available.

[35] This is the first available year for this variable. Note that urban population, number of college graduates by state, and migration data are from the Census Bureau.

4.6 Descriptive Statistics

In table 3, we tabulate "historical dividend" and "interest income," respectively, by state averaged over 1939–49 (no data available for Hawaii and Alaska), "growth in 1980s," "output 1977−1980" and the average output/income ratio. The table reveals very large geographical differences in historical income with the northeastern states displaying much higher levels than southern states, although Illinois and California also rank quite high on this measure. Delaware is an extreme outlier, especially regarding dividend income. "Output 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 (included in our estimation sample)—at 43,000 with Mississippi bringing up the rear at only 18,600. The oil states with the highest output levels also have the highest output/income ratios, with Alaska having the highest ratio of 1.63, followed by Wyoming at 1.37. The lowest ratio is found for Florida, likely reflecting capital income received by retirees no longer in the work force. In the following empirical analysis, Delaware is left out (as well as Hawaii and Alaska). Including Delaware has the effect of rendering the "historical dividend and interest income" variable less significant statistically but our main qualitative results are robust to the inclusion of this state.

Table 4 shows mean, maximum, minimum, and standard error (across the 50 states over 1980−2000) of the output/income ratio and the regressors. The output/income ratio has a mean of about 1 and has a standard deviation of 0.12—this is a large amount of variation because a value of, e.g., 1.15 means that 15 percent of value produced shows up as income in other states on net. "Output 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. In general, the regressors used in the level regressions show similar large variation. For the changes from the 1980s to the 1990s, displayed in the lower part of table 4, there is also large variation. The standard deviation of the change in the output/income ratio is 0.11 which means that on average changes in how much income from production in a state that goes to other state is in the order of 10 percent of state-level GDP. There is somewhat less variation in the "retirement" and "urbanization" variables, but there is large variation in growth rates with a standard deviation of 15 percent, which means that many states would grow more than 1.5 percent per year faster than the average state. This large variation in growth rates is what makes it possible for us to test the main implication of our simple model.

"Migration" also displays large variation across states with one state increasing population via in-migration by as much as 18 percent in the 1980s while another state lost 11 percent of population to out-migration.

4.7 Correlation between Regressors

In table 5, we display the matrix of correlations between the regressors in levels in top panel and in changes in the lower panel. "Historical dividend and interest income" and "output 1977−1980" are positively correlated with a correlation of 0.43. This correlation is, however, not so high that it precludes obtaining estimates of the separate impact of these regressors. The highest correlation for this sample (0.68) is between the "north" dummy and "historical dividend and interest income" reflecting the movement of capital from the northern regions in the early part of the century. The "oil share" is positively correlated with "output 1977−1980," but not with "historical dividend and interest income." Some other notably high correlations are "urbanization" and "historical dividend and interest income" (0.52), and "human capital" and "historical dividend and interest income" (0.60). The highest correlations in the lower panel is the correlation of "growth in 1980s" with "output/income in 1980s" (–0.63). The other correlations are all below 0.50.

4.8 Results from Cross-Sectional OLS Regressions

Change Regressions

Table 6 explores whether high growth in a state in the 1980s was followed by an increase in the output/income ratio in the 1990s (due to net capital in-flows during the 1980s and payment of net capital income). The regressions are performed for 47 states because we do not have "historical dividend and interest income" for Alaska and Hawaii and Delaware is very atypical. Regressors that are not statistically significant are left out of the tables here and their impact is reported in section 5.

The effect of "growth in 1980s" is estimated with a statistically significant t-statistic and this variable alone explains about 50 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 "growth in 1980s" supports our interpretation that an increase in TFP brings about growth and capital inflows. The estimated coefficient of about 0.33 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 0.033 higher in the 1990s than in the 1980s.[36] In section 2, equation (8), we derived the predicted effect on the output/income ratio of a productivity change hitting a state in the situation where all states are in steady-state. The prediction is that the output/income ratio will increase by about α times the percent change in GDP. The typical estimate of the capital share α is around 0.3, and our estimated value hits the "bulls eye" for this coefficient. We can get a rough order of magnitude of the net capital income flows involved as follows: the average per capita output of a state over our sample is about 30,000 dollars. An increase in the output/income ratio of 0.033 corresponds to 990 dollars worth of capital income being paid to other states annually.[37]

In column (2), we include the "output/income ratio in 1980s." This has the effect of lowering the estimated coefficient to "growth in 1980s" to about 0.13. This value is somewhat lower than the one predicted by the model but the estimated coefficient remains positive and of the correct sign. (The high correlation between "growth in 1980s" and the "output/income in 1980s" makes the determination of the individual impact of each somewhat hard to disentangle.) The coefficient to the "output/income in 1980s" is estimated at –0.42 with a very high level of statistical significance. This value implies that for a state with an output/income ratio different from the average value of 1, for example 1.020, over a 10 year span the output/income ratio would have converged to a value of 1.012.[38] This estimated value corresponds well with the predicted half-life of 15 years.

The other variable on our list which helps explain the change in the output/income ratio is the "change in urbanization." The sign of the coefficient to this regressor is consistent with urbanization capturing increases in TFP due to agglomeration, beyond what is already captured by the "growth in 1980s" variable. The marginal effect of urbanization on the output/income ratio is large, but it should be kept in mind that this variable shows only limited variation compared to "growth in 1980s" so it remains of secondary importance in explaining changes in the output/income ratio. By including "change in urbanization" the coefficient to "growth in 1980s" becomes larger and

[36]For example, North Carolina grew by 13 percent faster than the average state over the 1980s.

[37]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 9,900 dollars per capita were financed on net by other states.

[38]1.012 is found as 1.02+.02*(–.42), where 0.02 is the deviation from the average value of 1.

more significant with a value of 0.17. No other regressors were found to be significant, but many of our regressors change only slowly over time and may display little variation even from decade to decade, in which case the "change regressions" will not be able to pick up the potential effects. Therefore, our results do not rule out that other regressors may be important in the long run. The "level regressions" may better pick up such variables and we turn to such regressions shortly.[39]

Level regressions

Our main results for the level regressions are presented in table 7. Once again, the regressions are performed for 47 states because we do not have "historical 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 results in column (1) would be somewhat more statistically significant if Alaska were added (see section 5). Column (4) 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) "output 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), "output 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 in line with the predictions of our model if states with high current output on average are states with high growth in the recent pre-sample period, which seems a reasonable assumption for U.S. states.[40] 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,

[39]Our cross-sectional regressions, in column (2), have the form of regressing the change in the output/income ratio on the lagged output/income ratio and lagged growth, where a time period is a decade. If we shorten the time span we will have more observations in the time dimension and it is feasible to estimate the model using panel data techniques. We show the results of these regressions in section 5.3.

[40]We have (unofficial) GSP data going back to 1963, so we can actually verify a high value of "output 1977−1980" in the regression is capturing "recent growth". The level of output in 1977 can be considered the sum of output in 1963 and the amount of growth in output from 1963 to 1977 and, in principle, the positive coefficient to "output 1977−1980" could be due to the level of output in 1963, rather than to recent growth. We, therefore, in table 13, report the results from regressing the output/income ratio on output averaged over 1963–1966 (to minimize noise) and growth from 1966 to 1977. The growth rate is highly significant in such a regression. The coefficient to output 1963-1966 is also significant in such a regression but insignificant if the growth rate is not included in our regression. These results are clearly in accordance with our interpretation.

everything else equal. 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 clearly large in terms of economic significance.[41]

"Historical dividend and interest income," added in column (2), predicts the current output/income ratio negatively, as expected, with a very high t-statistic even though the historical variable refers to observations more than 50 years ago. The regression predicts 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. It is maybe more surprising that the effect is as long lasting as this result indicates.

The coefficient to "oil share," in column (3), is likewise highly statistically significant. The inclusion of this variable lowers the coefficient to "output 1977−1980" somewhat relative to column (2), but this is exactly what our model would lead us to believe: we consider "output 1977−1980" as an indicator of high total factor productivity which, *ceteris paribus*, should attract outside capital leading to a higher output/income ratio. But an oil endowment is a more direct measure of productivity of capital in the "oil states" and including "oil share" should, therefore, lower the significance of the impact of "output 1977−1980." 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 in the order of 40,000 dollars, 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 "retirement," in column (4), we find a negative significant coefficient in line with our

[41] If productivity "catch-up" were still important during our sample, we would find the output/income ratio (past net capital flows) positively correlated with growth but negatively correlated with the level of output. (States with low human capital improving productivity and attracting capital, while still having below average output.)

expectations. 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.

5 Robustness Analysis

5.1 Other Measures of Income

The validity of the way we interpret the results is highly dependent on the income variable being a reasonable approximation to GNI, so we find it important to demonstrate that our main results are robust to reasonable alternative ways of calculating "income." In table 8, we examine whether the change regressions are sensitive to the definition of "income." Column (1) repeats our preferred regression, while column (2) shows the results of the same specification when personal income is adjusted for "federal transfers." This lowers the coefficient to "growth in 1980s" slightly and the coefficient to "change in urbanization" quite significantly. This may simply be due to recipients of federal transfers being more likely to live in rural areas.[42] In column (3), we adjust personal income for "cross-state commuters' wage income." By doing so we isolate the component of wage income generated within the state borders. The only meaningful change relative to column (1) is that the exclusion of commuters' wage income reduces the size of the coefficient to "change in urbanization" somewhat. This is consistent with commuters crossing state borders to work in highly urbanized areas such as New York or Washington, D.C.[43]

In column (4), we use a more elaborate approximation to GNI based on the "state income" variable as discussed in the data section. This has little effect on the estimated coefficients to "growth in 1980s" and "output/income in 1980s," our main regressors. In column (5), we consider the change in net liabilities (total liabilities of residents of a state minus total assets) from Duczynski (2000). As argued in the data section this variable is independently constructed and based on

---

[42]If income is pre-transfers+transfers and transfers correlates negatively with urbanization, we will observe a higher coefficient when regressing output/(pre-tranfers+transfers) [column (1)] on urbanization than when regressing output/pre-transfers on urbanization [column (2)].

[43]If income is non-commuter-income+commuter-income and commuter-income correlates negatively with urbanization, we will observe a higher coefficient when regressing output/(non-commuter-income+ commuter income) [column (1)] on urbanization than when regressing output/non-commuter-income [column (3)].

different data. Duczynski's data provides a more direct test of the implication that capital flows into states with high TFP. We find that states with high growth in the 1980s increased their net external liabilities and, therefore, held relatively fewer net assets in the 1990s, consistent with capital flowing into the high-growth states on net. We also find that "net external liabilities in the 1980s" again indicates convergence, while "change in urbanization" is statistically insignificant. These results imply that a state which grew 10 percent faster than average from 1981 to 1990 (1 percent annually) increases its net liabilities by about 2,540 dollars per capita (25,400 times 0.1). If output 1977−1980 was 25,000 dollars on average, this implies that in order to increase output by 2,500 dollars, capital in the amount of 2,540 dollars was attracted from out of state. As a result, the results based on these independent estimates are of similar orders of magnitude.

Table 9 explores 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 first four columns (the regressand has a different interpretation in column (5)). In column (2), personal income is adjusted for "federal transfers;" the only meaningful effect of this adjustment is on the "retirement" variable, which becomes statistically insignificant. This indicates that a large part of the income of retirees consists of federal transfers (notably social security and medicare) which, of course, is fully consistent with casual observation. In column (3), we adjust personal income for "cross-state commuters' wage income." This adjustment lowers the coefficients to "historical dividend and interest income" and "output 1977−1980," although these regressors are still statistically significant. The coefficient to "oil share" is similar to the one found column (2). In column (4), "approximate GNI" is used rather than personal income but the estimated coefficients are quite similar to those of column (1) except that "retirement" is not statistically significant since federal transfers are not part of this "approximate GNI." Nonetheless, the overall impression is that our main results are robust to the way the income variable is measured.

In column (5), we use Duczynski's (2000) estimates of "net external liabilities." Since now the regressand is the stock of liabilities per capita, the order of magnitude of the estimated coefficients is different. For example, the coefficient to output 1977−1980 implies that a 10 percent higher output is associated with an approximate 2,000 dollars higher net per capita liabilities. If rates of return are roughly similar across states, say 10 percent, this can be translated into net factor income flows: an increase in output from 20,000 dollars to 22,000 dollars and a change in liabilities from (say) 0 to 2,000 dollars would lead to a change in outgoing capital income flows of 200 dollars per year and a change in the output/income ratio from 1 to 22,000/21,800=1.01. This 1 percent increase in the output/income ratio is smaller than the 3 percent increase suggested by the results of table 7 because the calculation done here assumes no direct effect on ex post capital income flows from higher productivity and is limited to the effect of the change in net ownership.[44] The overall message of the results is, however, similar to those obtained using the ratio of output to income and the t-statistics are statistically significant as well when we use Duczynski's asset variables. The remaining results for this variable are perfectly sensible: states with high income in the past still have lower levels of net liabilities, oil states have high levels of liabilities, and states with many retirees have lower levels of net liabilities. Overall, the results using net liabilities all support our previous interpretations.

5.2 Additional Controls

Table 10 explores the role of adding other regressors to the level regression. Due to the somewhat limited number of degrees-of-freedom, we add each of these regressors one-by-one to the specification in table 7. (We also experimented with regressions that allowed for more, or even all, potential regressors. The results from such regressions show the same patterns as table 10, in terms of which regressors are significant.) The results of table 10 point to none of the additional regressors being significant. The coefficient to the dummy variable "north" is not significant. In (not tabulated) regressions where "historical dividend and interest income" is left out, the regressor "north" is highly significant. This agrees with the historical record of capital flowing from the northeast to the rest of the U.S. as people moved (broadly speaking) West and South and investment opportunities opened up in these regions. This effect is, however, better captured by the "historical dividend and interest income" variable in the sense that the multiple regression clearly assigns the significant coefficient to the economic variable rather than the geographic variable north. "Urbanization" has an insignificant negative effect as has "human capital." Finally, we find an insignificant positive coefficient to "manufacturing share" and an insignificant negative coefficient to "agricultural share."

In table 11, we, in column (1), show the results for 50 states. It is interesting that the coefficient

[44] Likely, Duczynski's imputations are also a lower bound on capital income moving between states.

to “growth in 1980s” now is 0.27, which is very close to the predicted value. In the remaining columns, we revert to our usual sample of 47 states and add potential determinants of the change in the output/income ratios, namely “migration in 1980s” and the “change in retirement.” However, none of these variables help explain the regressand. Most likely, these regressors change too slowly even from decade to decade.

5.3 Panel Regressions

In our model, we assume that TFP changes discretely from decade to decade. *A priori*, decades seem long enough for adjustment costs in investments to be negligible. If, however, productivity shocks are short lived, we will have little variation from decade to decade. Barro and Sala-i-Martin (1991 and 1992) in their growth regressions for U.S. states over decades of the 20th century find much higher R-squares when they allow for sectoral shocks. Sectoral productivity shocks are consistent with the (state-level) aggregate A_i being different across states and changing from decade to decade (since A_i is the average productivity level and sectors have different weights in the GDP of different states). Glick and Rogoff (1995) find that they cannot reject unit roots in country-level Solow-residuals; this is also consistent with productivity shocks not averaging out over a decade.

We experimented with panel regressions for shorter time spans as shown in table (12). The coefficient to lagged growth is robust to shortening the time span while the size of the coefficient to the lagged output/income ratio declines. The coefficient to the lagged ratio measures how much the output/income ratio would revert towards unity, ceteris paribus, during one time period. Therefore, the numerical decline in this coefficient is due to the shortening of the length of each period and the estimates imply similar half-lives for the reversion of the output/income ratio to unity. All in all, our results are robust to the choice of period length within the range considered in table (12).

6 Conclusion

We study net capital income flows between U.S. states. In a simple neoclassical model with capital ownership being perfectly diversified across states, with total factor productivity (TFP) that varies across states and over time, and no barriers to movement of capital between states, capital should flow to states that experience a relative increase in TFP. While TFP is not directly observed, we can identify states with high TFP growth per capita as states with high output growth per capita. We use the state-level ratio of output to personal income as a measure of net capital income outflows and, therefore, an indicator of past net capital inflows. We then examine if net capital income flows out of the states which experience relative increases in TFP. We find this prediction clearly confirmed by the data. Simple "back of the envelope" calculations reveal that net capital inflows that are associated with these capital income outflows are very large. This implies that frictionless capital markets may have large economic effects by allowing investment to be directed to states where it can be most efficiently employed.

Our results provide empirical support for the notion that, within a federation, where language, currency and institutional barriers are not present, capital does flow from regions where the level of total factor productivity is low to regions where it is high. The point estimates for the change in the output/income ratio following periods of above average growth take values quite consistent with the predictions of a simple open-economy neoclassical model with perfect mobility of capital, immobile labor, and varying TFP. The rate of convergence of the output/income ratio, in the absence of further changes in TFP, is also quite consistent with the implications of the model.

Our results also show that if capital ownership is fully diversified then a typical state should hold foreign capital in an amount of about 3 times GDP. Almost all countries hold amounts of foreign asset below the level of GDP in spite of the recent increase in the gross foreign asset and liability positions in the OECD. On the other hand, net capital flows and positions between countries—or, current account deficits and surpluses—are much smaller than predicted by standard neoclassical models. Lower than predicted net capital flows may be due to inherent failures of the frictionless model or to frictions associated with national borders. Our evidence shows that capital flows between U.S. states are consistent with the predictions of a simple frictionless neoclassical model. Consequently, frictions associated with national borders are likely to be a significant part of the explanation for "low" international capital flows.

References

Alfaro, Laura, Sebnem Kalemli-Ozcan and Vadym Volosovych (2003), "Why Doesn't Capital flow from Rich Countries to Poor Countries? An Empirical Investigation," University of Houston, mimeo.

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

Backus, David, Patrick Kehoe and Finn Kydland (1992), "International Real Business Cycles," *Journal of Political Economy* 100, 745–75.

Barro, Robert, J. and Xavier Sala-i-Martin (1991), "Convergence Across States and Regions," *Brookings Papers on Economic Activity,* 1991, No. 1, 107–182.

Barro, Robert, J. and Xavier Sala-i-Martin (1992), "Convergence," *Journal of Political Economy,* 100, 223–251.

Barro, Robert, J. and Xavier Sala-i-Martin (1995), *Economic Growth,* Cambridge: MIT Press.

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

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.

Blanchard, Olivier and Francesco Giavazzi (2002), "Current Account Deficits in the Euro Area: The End of the Feldstein-Horioka Puzzle," *Brookings Papers on Economic Activity* 2, 147–186.

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

Budd, John W. and Matthew J. Slaughter (2000), "Are Profits Shared Across Borders? Evidence on International Rent Sharing," NBER Working Paper no. 8014.

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," Mimeo, Duke University.

Coval, Joshua D. and Tobias J. Moskowitz (1999), "Home Bias at Home: Local Equity Preference in Domestic Portfolios," *Journal of Finance* 54, 2045–2074.

Drabenstott, Mark (1999), "Consolidation in U.S. Agriculture: The New Rural Landscape and Public Policy," *Federal reserve Bank of Kansas City Economic Review* First Quarter, 63–71.

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

Feldstein, Martin and Charles Horioka (1980), "Domestic Savings and International Capital Flows," *Economic Journal* 90, 314–29.

French, Kenneth and James Poterba (1991), "Investor Diversification and International Equity Markets," *American Economic Review: Papers and Proceedings* 81, 222–226.

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

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, Bent E. Sørensen and Oved Yosha (2001), "Economic Integration, Industrial Specialization and the Asymmetry of Macroeconomic Fluctuations," *Journal of International Economics* 55, 107–137.

Lane, Philip and Gian Maria Milesi-Ferretti (2001), "The External Wealth of Nations: Measures of Foreign Assets and Liabilities for Industrial and Developing Countries,"*Journal of International Economics* 55, 263–294.

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 Kenneth Rogoff (2000), "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" *NBER Macroeconomics Annual 2000.*

Ostergaard, Charlotte, Bent. E. Sørensen, and Oved Yosha (2002), "Consumption and Aggregate Constraints: Evidence from US States and Canadian Provinces." *Journal of Political Economy* 110, 634–645.

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.

Sinn, Stefan (1992), "Saving-Investment Correlations and Capital Mobility: On the Evidence from Annual Data," *Economic Journal* 102, 1162–1170.

Sørensen, Bent E., Yi-Tsung Wu, Yu Zhu and Oved Yosha (2005), "Home Bias and International Risk Sharing: Twin Puzzles Separated at Birth," Working Paper, University of Houston.

Tesar, Linda and Ingrid Werner (1995), "Home Bias and High Turnover," *Journal of International Money and Finance* 14, 467–92.

van Wincoop, Eric (2000), "Intranational versus International Saving-Investment Co-movements," in Gregory Hess and Eric van Wincoop, eds., *Intranational Macroeconomics*, New York: Cambridge University Press.

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 available for 1977–2000. Less reliable GSP data exists for 1963–1976.

SPI: State-level Personal Income (SPI) is published by the BEA. The relation of personal income to GDP in the aggregate U.S. National Income and Product Accounts (NIPA) is shown in appendix A. SPI is available for our entire sample.

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). These 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.

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: This series is an estimate of the resources that (*ceteris paribus*) would have been available for consumption by the residents of states, had there been no fiscal intervention on part of the federal government. The detailed construction of State Income involves a large number of data sources and a number of imputations; see Asdrubali, Srensen, 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.

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.

Urban Population: Urban population by state is available from the Census Bureau for the census years 1980, 1990, and 2000.

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

College Graduates: The proportion of college graduates in the population by state is published by the Census Bureau for the years 1989–2000.

Migration: Net migration by state is the sum of three components: (1) net inter-state migration, (2) net international migration by state and (3) net number of federal employees moving in and out of US. Conceptually, the sum of the three components is the change in population that is not due to natural growth (births minus deaths). The Census Bureau publishes annual estimates of the sum for 1980–1999. In addition, net inter-state migration from 1975 to 1980 (cumulative, not annual) is also available. We use the percent of net inter-state migration from 1975 to 1980 in state population in 1980.

Oil Prices: This series was obtained from the Energy Information Administration in the U.S.

Department of Energy for 1968–2000.

State "Current Accounts" This investment and aaving data for 1953 and 1957 is from Romans (1965).

Net External Liabilities: By utilizing the difference between property income received and property income produced, Duczynski (2000) estimates net external assets for U.S. states for various years as a percent of GSP. Updated estimates for 1977–2001 have been made available to us by Petr Duczynski. By multiplying Duczynski's estimates by GSP and reversing the sign, we obtain net external liabilities (rather than assets).

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.

Manufacturing Share: The BEA publishes estimates of the value added in the "Manufacturing" industry sector by state. "Manufacturing Share" is the percent of this sector in GSP.

Agriculture Share: The BEA publishes estimates of the value added in the "Agriculture, forestry, fishing, and hunting" industry sector by state. "Agriculture 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.

Change in Output/Income ratio: The average of the Output-Income ratio over 1991–2000 minus the average of the ratio over 1981–1990.

Change in Urbanization: The difference between 1990 and 1980 in the percent of individuals living in urban settings.

Change in Retirement: The difference between 1990 and 1980 in the percent of state population age 65 and above.

Growth in 1980s: The growth rate of GSP per capita in 2000 prices from 1980 to 1990.

Migration in 1980s: The percent of net inter-state migration from 1985 to 1990 in state population in 1985.

North: An indicator variable that takes the value 1 if a state is in one of northern regions and 0 otherwise. These states are: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont (New England); Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania (Mid-East); Illinois, Indiana, Michigan, Ohio, Wisconsin (Great Lakes).

SPI-transf: SPI minus Federal Transfers.

SPI-commut: SPI minus Net Commuters' Wage Income (Adjustment for Residence).

Approx. GNI: State Income from Asdrubali et al. (1996) plus Corporate Retained Earnings.

Table 1: **State "Current Accounts" 1953 and 1957**

	I–S in 1953 per capita	I–S in 1957 per capita	I–S in 1953 millions	I–S in 1957 millions
Alabama	17.69	102.61	54	319
Alaska	.	.	.	.
Arizona	190.16	106.67	170	120
Arkansas	89.33	91.17	159	158
California	–100.48	–142.95	–1231	–2039
Colorado	–33.54	31.85	–48	53
Connecticut	–190.5	–154.3	–413	–364
Delaware	–319.09	–647.89	–112	–276
Florida	–83.99	–155.99	–278	–682
Georgia	4.5	42.22	16	159
Hawaii	.	.	.	.
Idaho	149.33	123.05	89	79
Illinois	–96.64	3.1	–876	30
Indiana	73.41	228.09	307	1033
Iowa	–127.04	11.05	–334	30
Kansas	18.05	112.31	36	239
Kentucky	62.69	45.77	182	134
Louisiana	204.12	240.13	585	748
Maine	–38.34	–40.3	–35	–38
Maryland	–84.14	–25.06	–216	–72
Massachusetts	–152.31	–228.65	–732	–1127
Michigan	–13.63	55.75	–93	422
Minnesota	–78.03	–51.92	–238	–170
Mississippi	17.1	131.7	36	275
Missouri	–131.34	–81.88	–528	–343
Montana	116.88	86.96	72	58
Nebraska	–120.64	84.65	–159	118

	I–S in 1953 per capita	I–S in 1957 per capita	I–S in 1953 millions	I–S in 1957 millions
Nevada	92.31	19.23	18	5
New Hampshire	–202.93	–90.91	–111	–52
New Jersey	–75.35	–85.06	–394	–488
New Mexico	256.61	173.55	194	147
New York	–226.51	–292.11	–3517	–4783
North Carolina	20.63	33.42	85	146
North Dakota	200.33	127.45	122	78
Ohio	134.68	86.61	1157	815
Oklahoma	–4.58	82.82	–10	189
Oregon	7.5	66.59	12	114
Pennsylvania	–12.29	–101.24	–131	–1109
Rhode Island	–105.52	–195.06	–86	–166
South Carolina	29.8	73	65	166
South Dakota	–23.15	37.54	–15	25
Tennessee	50.92	44.85	169	154
Texas	89.97	203.31	750	1844
Utah	27.06	169.49	20	140
Vermont	–63.32	–21.28	–24	–8
Virginia	9.84	16.13	35	62
Washington	26.76	108.3	66	295
West Virginia	141.01	239.83	272	442
Wisconsin	–50.2	6.86	–176	26
Wyoming	210.34	286.62	61	90

Notes: These data are from Romans (1965). "I−S" is the difference between state-level investment and state-level saving for the given year. Romans 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.

Table 2: **State "Current Accounts" and Net Capital Income**

Dependent Variable: Log of Output-Income Ratio

	(1)	(2)	(3)	(4)
Out/Inc Sample	1963−1970	1971−1980	1981−1990	1991−2000
States	47	47	47	47
Investment minus Saving in 1953−57	0.09 (5.04)	0.10 (4.30)	0.08 (2.54)	0.04 (2.32)
R^2	0.51	0.50	0.29	0.19

Notes: 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). "Output/Income Ratio" is output divided by income (and normalized by U.S. output/income), where output is the Gross State Product (GSP) and income is the State Personal Income (SPI), averaged over the "Out/Inc Sample". "Investment minus Saving in 1953−57" is the difference between state-level investment and state-level saving, averaged for the two years for which this data is available, 1953 and 1957. State-level investment and state-level saving are from Romans (1965) and used in thousands of dollars in 2000 prices in the above regression. See table 1 for the detailed explanations of state-level investment and saving estimates. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Table 3: **Descriptive Statistics by State**

	Historical		Growth in	Output	
	Dividend Income	Interest Income	1980s	1977−1980	Output/Income
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

Table 3: Descriptive Statistics by State—continued

	Historical		Growth in	Output	
	Dividend Income	Interest Income	the 1980s	1977−1980	Output/Income
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: "Historical Dividend & Interest Income" is the dividend and interest income per capita in 2000 prices, averaged over 1939−1949. "Growth in 1980s" is the sum of the yearly growth rates of GSP per capita, over 1981−1990. "Output 1977−1980" is GSP per capita in 2000 prices, averaged over 1977−1980. "Output/Income Ratio" is output divided by income (and normalized by U.S. output/income), where output is the Gross State Product (GSP) and income is the State Personal Income (SPI), averaged over 1981−2000.

Table 4: **Descriptive Statistics**

	Mean	Std.dev.	Max	Min
Output/Income ratio	1.02	0.12	1.63	0.88
Output 1977−1980 (1,000$ per capita)	25.8	6.8	63.4	18.6
Historical Div&Int Inc. (1,000$ per capita)	0.69	0.46	2.70	0.18
Oil Share (percent)	3.00	6.00	22.00	0.00
Retirement (percent)	11.00	2.00	18.00	3.00
Migration (percent)	0.10	5.60	12.00	–19.00
Urbanization (percent)	68.00	15.00	94.00	34.00
Human Capital (percent)	20.00	4.00	28.00	11.00
Manufacturing Share (percent)	21.00	9.00	36.00	5.00
Agriculture Share (percent)	4.00	4.00	18.00	1.00
Change in Output/Income ratio	–0.01	0.11	0.16	–0.61
Change in Urbanization (percent)	1.00	2.00	5.00	–3.00
Change in Retirement (percent)	1.00	1.00	3.00	0.00
Growth in 1980s (percent)	13.24	15.60	40.49	–46.04
Output/Income in 1980s	1.03	0.17	1.93	0.87
Migration in 1980s (percent)	0.00	5.00	18.00	–11.00

Notes: 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). "Output/Income Ratio" is output divided by income (and normalized by U.S. output/income), where output is the Gross State Product (GSP) and income is the State Personal Income (SPI), averaged over 1981−2000. "Output 1977−80" is GSP per capita in 2000 prices, averaged over 1977−1980. "Historical Dividend & Interest Income" is the dividend and interest income per capita in 2000 prices, averaged over 1939−1949. "Oil Share" is GSP in the oil and mineral extraction divided by the total GSP of the state, averaged over 1977−1980. "Retirement" is the share of retirees in state population, in 1980. "Migration" is net state migration as a share of total state population, in 1975−1980. "Urbanization" is the number of individuals living in urban settings divided by state population, in 1980. "Human Capital" is the share of population that has a bachelors degree or more, in 1989. "Manufacturing Share" is GSP in the manufacturing divided by the total GSP of the state, averaged over 1977−1980. "Agriculture Share" is GSP in the agriculture divided by the total GSP of the state, averaged over 1977−1980. "Change in the output-income ratio" is the average of the ratio over 1991−2000 minus the average of the ratio over 1981−1990. "Change in Urbanization" is the number of individuals living in urban settings divided by state population in 1990 minus the number of individuals living in urban settings divided by state population in 1980. "Change in Retirement" is the share of retirees in state population in 1990 minus the share of retirees in state population in 1980. "Migration in 1980s" is net state migration as a share of total state population, in 1985−1990. "Growth in 1980s" is the sum of the yearly growth rates of GSP per capita, over 1981−1990.

Table 5: **Correlation Matrix**

	Output	Hist Inc.	Oil	Ret	Mig	North	Urban	HK	Manuf	Agr
Output	1.00									
Hist Inc.	0.43	1.00								
Oil	0.48	–0.24	1.00							
Ret	–0.39	0.09	–0.36	1.00						
Mig	–0.06	0.09	–0.17	–0.20	1.00					
North	–0.02	0.68	–0.31	0.16	0.02	1.00				
Urban	0.52	0.55	0.03	–0.14	0.13	0.18	1.00			
HK	0.36	0.60	–0.02	–0.16	–0.06	0.25	0.45	1.00		
Manuf	–0.36	0.09	–0.51	0.22	0.20	0.53	–0.10	–0.23	1.00	
Agr	–0.13	–0.42	–0.00	0.31	–0.39	–0.39	–0.42	–0.13	–0.33	1.00

	Growth80	Out/inc80	ΔUrban	ΔRet	Mig80
Growth80	1.00				
Out/inc80	–0.63	1.00			
ΔUrban	–0.30	0.20	1.00		
ΔRet	–0.41	0.16	0.21	1.00	
Mig80	0.43	–0.37	–0.02	–0.17	1.00

Notes: 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). "Output" is GSP per capita in 2000 prices, averaged over 1977−1980. "Hist Inc." is the dividend and interest income per capita in 2000 prices, averaged over 1939−1949. "Oil" is GSP in the oil and mineral extraction divided by the total GSP of the state, averaged over 1977−1980. "Ret" is the share of retirees in state population, in 1980. "Mig" is net state migration as a share of total state population, in 1975−1980. "Urban" is the number of individuals living in urban settings divided by state population, in 1980. "HK" is the share of population that has a bachelors degree or more, in 1989. "Manuf" is GSP in the manufacturing divided by the total GSP of the state, averaged over 1977−1980. "Agr" is GSP in the agriculture divided by the total GSP of the state, averaged over 1977−1980. "ΔUrban" is the number of individuals living in urban settings divided by state population in 1990 minus the number of individuals living in urban settings divided by state population in 1980. "ΔRet" is the share of retirees in state population in 1990 minus the share of retirees in state population in 1980. "Mig80" is net state migration as a share of total state population, in 1985−1990. "Out/Inc80" is the log of average of the output/income ratio over 1981−1990. "Growth80" is the sum of the yearly growth rates of GSP per capita, over 1981−1990.

Table 6: **Determinants of the Change in Net Capital Income Flows**

Dep. Var: Change in Output/Income Ratio: 1980s−1990s

	(1)	(2)	(3)
States	47	47	47
Growth in 1980s	0.33	0.13	0.17
	(3.55)	(3.22)	(5.15)
Output/Income in 1980s	–	–0.42	–0.42
	–	(5.11)	(5.75)
Change in Urbanization	–	–	0.97
	–	–	(4.67)
R^2	0.49	0.74	0.80

Notes: 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). "Change in the output-income ratio" is the average of the ratio over 1991−2000 minus the average of the ratio over 1981−1990. "Output/Income in 1980s" is the log of the average of the output/income ratio over 1981−1990. "Growth in the 1980s" is the sum of the yearly growth rates of GSP per capita, over 1980−1990. "Change in Urbanization" is the number of individuals living in urban settings divided by state population in 1990 minus the number of individuals living in urban settings divided by state population in 1980. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Table 7: **Determinants of Net Capital Income Flows**

Dependent Variable: Log of Output/Income Ratio

	(1)	(2)	(3)	(4)
States	47	47	47	47
Output 1977−1980	0.29	0.43	0.29	0.24
	(3.12)	(5.93)	(4.95)	(4.41)
Historical Dividend	–	–0.09	–0.06	–0.05
&Interest Income	–	(5.71)	(3.97)	(3.35)
Oil Share	–	–	0.56	0.54
	–	–	(3.14)	(3.47)
Retirement	–	–	–	–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). "Output/Income Ratio" is the logarithm of output divided by income (and normalized by U.S. output/income), where output is the Gross State Product (GSP) and income is the State Personal Income (SPI), averaged over 1981−2000. "Output 1977−1980" is the logarithm of GSP per capita in 2000 prices, averaged over 1977−1980. "Historical Dividend & Interest Income" is the logarithm of dividend and interest income per capita in 2000 prices, averaged over 1939−1949. "Oil Share" is the logarithm of GSP in the oil and mineral extraction divided by the total GSP of the state, averaged over 1977−1980. "Retirement" is the logarithm of the share of retirees in state population, in 1980. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Table 8: **Determinants of the Change in Net Capital Income Flows: Other Measures of "Income"**

	(1)	(2)	(3)	(4)	(5)
Dependent Var.	$\Delta\frac{GDP}{Inc.I}$	$\Delta\frac{GDP}{Inc.II}$	$\Delta\frac{GDP}{Inc.III}$	$\Delta\frac{GDP}{Inc.IV}$	ΔNEL
Income measure	SPI	SPI–transf.	SPI–commut.	approx GNI	Net Ext.Lib.
States	47	47	47	47	47
Growth in 1980s	0.17	0.13	0.18	0.14	25.40
	(5.15)	(3.94)	(5.52)	(3.78)	(3.87)
Output/Income in 1980s	–0.42	–0.39	–0.43	–0.34	–
	(5.75)	(4.52)	(7.05)	(4.63)	–
Net Ext. Liab. in 1980s	–	–	–	–	–0.31
	–	–	–	–	(4.07)
Change in Urban.	0.97	0.56	0.77	0.35	23.02
	(4.67)	(2.89)	(3.52)	(1.63)	(0.56)
R^2	0.80	0.77	0.81	0.70	0.71

Notes: 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). "Change in the output-income ratio" is the average of the ratio over 1991−2000 minus the average of the ratio over 1981−1990. "Output-Income Ratio" is the logarithm of output divided by income (and normalized by U.S. output/income), averaged over 1981−2000, where output is the 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. Column (5) uses "Net External Liabilities per capita (NEA)" from Duczynski (2000) in thousands of dollars and in 2000 prices, averaged over 1981−2000. The mean of this variable is –0.54; the standard deviation is 2.12; the maximum is 2.80; the minimum is –12.27. "Growth in 1980s" is the sum of the yearly growth rates of GSP per capita, over 1980−1990. "Change in Urbanization" is the number of individuals living in urban settings divided by state population in 1990 minus the number of individuals living in urban settings divided by state population in 1980. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Table 9: **Determinants of Net Capital Income Flows: Other Measures of "Income"**

	(1)	(2)	(3)	(4)	(5)
Dependent Var.	$\frac{GDP}{Inc.I}$	$\frac{GDP}{Inc.II}$	$\frac{GDP}{Inc.III}$	$\frac{GDP}{Inc.IV}$	$NEL.$
Income measure	SPI	SPI–transf.	SPI–commut.	approx GNI	Net Ext.Lib.
States	47	47	47	47	47
Output 1977−1980	0.24	0.20	0.13	0.15	18.74
	(4.41)	(3.20)	(2.76)	(3.20)	(221)
Historical Dividend	–0.05	–0.06	–0.02	–0.06	–10.25
&Interest Income	(3.35)	(3.97)	(2.13)	(4.23)	(4.72)
Oil Share	0.54	0.65	0.62	0.52	88.21
	(3.47)	(3.53)	(4.43)	(2.97)	(3.63)
Retirement	–0.11	–0.04	–0.17	–0.06	–25.02
	(2.72)	(0.79)	(5.44)	(1.47)	(3.59)
R^2	0.76	0.72	0.78	0.69	0.76

Notes: 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). "Output/Income Ratio" is the logarithm of output divided by income (and normalized by U.S. output/income), averaged over 1981−2000, where output is the 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. Column (5) uses "Net External Liabilities per capita" from Duczynski (2000) in thousand dollars and in 2000 prices, averaged over 1981−2000. The mean of this variable is –0.54; the standard deviation is 2.12; the maximum is 2.80; the minimum is –12.27. "Output 1977−1980" is the logarithm of GSP per capita in 2000 prices, averaged over 1977−1980. "Historical Dividend & Interest Income" is the logarithm of dividend and interest income per capita in 2000 prices, averaged over 1939−1949. "Oil Share" is the logarithm of GSP in the oil and mineral extraction divided by the total GSP of the state, averaged over 1977−1980. "Retirement" is the logarithm of the share of retirees in state population, in 1980. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Table 10: **Determinants of Net Capital Income Flows: Additional Controls**

Dependent Variable: Log of Output/Income Ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
States	50	47	47	47	47	47	47
Output 1977−1980	0.40	0.24	0.22	0.26	0.24	0.24	0.25
	(6.45)	(4.37)	(3.60)	(4.69)	(4.44)	(4.23)	(3.83)
Historical Div.	–	–0.05	–0.04	–0.04	–0.05	–0.05	–0.05
&Interest Inc.	–	(3.39)	(2.38)	(3.31)	(3.10)	(3.42)	(2.76)
Oil Share	–	0.54	0.55	0.53	0.54	0.57	0.53
	–	(3.52)	(3.56)	(3.59)	(3.56)	(3.59)	(3.33)
Retirement	–	–0.11	–0.11	–0.11	–0.11	–0.11	–0.10
	–	(2.68)	(2.76)	(2.77)	(2.80)	(2.70)	(2.07)
Migration	–	–0.07	–0.09	–0.07	–0.07	–0.06	–0.08
	–	(0.95)	(1.08)	(1.01)	(0.86)	(0.83)	(0.98)
North	–	–	–0.01	–	–	–	–
	–	–	(0.74)	–	–	–	–
Urbanization	–	–	–	–0.03	–	–	–
	–	–	–	(1.18)	–	–	–
Human Capital	–	–	–	–	–0.01	–	–
	–	–	–	–	(0.35)	–	–
Manufacturing	–	–	–	–	–	0.06	–
Share	–	–	–	–	–	(0.60)	–
Agriculture	–	–	–	–	–	–	–0.06
Share	–	–	–	–	–	–	(0.31)
R^2	0.64	0.77	0.77	0.78	0.77	0.77	0.77

Notes: The first column includes Alaska, Hawaii, and Delaware. See table 4 for detailed explanations of all the variables. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Table 11: **Determinants of the Change in Net Capital Income Flows: Additional Controls**

Dep. Variable: Change in Output/Income Ratio: 1980s−1990s

	(1)	(2)	(3)
States	50	47	47
Growth in 1980s	0.27	0.16	0.15
	(2.87)	(4.67)	(3.95)
Output/Income in 1980s	–0.47	–0.42	–0.41
	(3.60)	(5.73)	(5.96)
Change in Urban	–	0.98	0.94
	–	(4.64)	(4.37)
Change in Retirement	–	–0.32	–0.30
	–	(0.60)	(0.58)
Migration in 1980s	–	–	0.21
	–	–	(1.38)
R^2	0.64	0.81	0.81

Notes: The first column includes Alaska, Hawaii, and Delaware. See table 4 for detailed explanations of all the variables. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Table 12: **Determinants of the Change in Net Capital Income Flows: Panel Regressions**

Dep. Var: Change in Output/Income Ratio

	(1)	(2)	(3)
Lagged Growth	0.13	0.17	0.12
	(3.22)	(4.14)	(2.34)
Lagged Output/Income	–0.42	–0.38	–0.35
	(5.11)	(9.09)	(7.76)
Interval length	10	7	5
Observations	47	94	141
Sample	1981−2000	1980−2000	1981−2000
R^2	0.74	0.70	0.57

Notes: 47 observations (missing data for Alaska and Hawaii; 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 3 periods during 1980−2000. Our RHS variables are lagged by one period, so the number of observations is (3−1)*47=94. Column (1) reproduces column (2) of table 6. "Lagged Growth" is the total growth of GSP per capita within the previous period; thus, in column (2) it is the total growth over 7 years. "Lagged Output/Income" is the value the output/income ratio in the previous period. Heteroskedasticity robust t-statistics in parentheses.

Table 13: **(Appendix) Determinants of Net Capital Flows: Capturing Pre-Sample Recent Growth**

Dependent Variable: Log of Output-Income Ratio

	(1)	(2)	(3)
Out/Inc Sample	1981−2000	1981−2000	1981−2000
States	47	47	47
Output 1977−1980	0.29		
	(3.12)		
Output 1963−1966		0.10	0.22
		(1.24)	(3.66)
Growth 1966−1977			0.57
			(4.35)
R^2	0.34	0.05	0.47

Notes: 47 observations (missing data for Alaska and Hawaii; the outlier Delaware is left out). “Output/Income Ratio” is output divided by income (and normalized by U.S. output/income), where output is the Gross State Product (GSP) and income is the State Personal Income (SPI), averaged over 1981−2000. “Output 1977−1980” is the logarithm of the average of GSP over 1977−1980. “Output 1963−1966” is the logarithm of the average of GSP over 1963−1966. “Growth 1966−1977” is the growth rate of GSP during 1966−1977. A constant was included in all specifications. Heteroskedasticity robust t-statistics in parentheses.

Figure 1

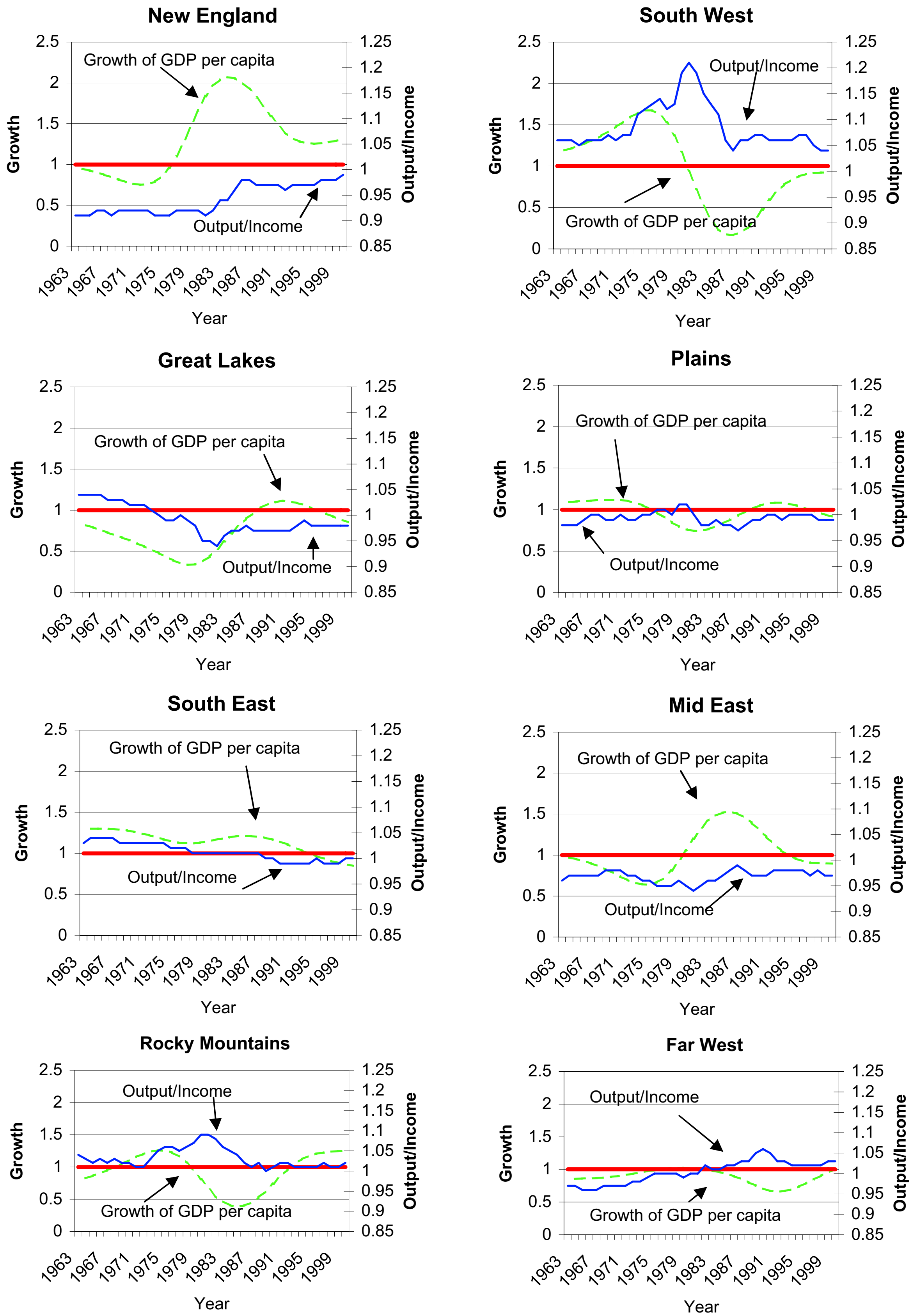
New England
Growth of GDP per capita
Output/Income
South West
Output/Income
Growth of GDP per capita
Great Lakes
Growth of GDP per capita
Output/Income
Plains
Growth of GDP per capita
Output/Income
South East
Growth of GDP per capita
Output/Income
Mid East
Growth of GDP per capita
Output/Income
Rocky Mountains
Output/Income
Growth of GDP per capita
Far West
Output/Income
Growth of GDP per capita
Growth
Output/Income
Year
0
0.5
1
1.5
2
2.5
0.85
0.9
0.95
1
1.05
1.1
1.15
1.2
1.25
1963
1967
1971
1975
1979
1983
1987
1991
1995
1999

Figure 2: Average Output/Income (Alaska,Louisiana,Wyoming) versus World (real) Price of crude oil