IIIS Discussion Paper

No.72 / April 2005

Net Capital Flows and Productivity: 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
University of Houston and CEPR

IIIS Discussion Paper No. 72

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

Sebnem Kalemli-Ozcan
Ariell Reshef
Bent E. Sørensen
Oved Yosha

Net Capital Flows and Productivity: 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

April 2005

Abstract

We study net capital flows between U.S. states. We present a simple neoclassical model in which total factor productivity (TFP) varies across states and over time and where capital freely moves across state borders. In this framework capital flows to states that experience a relative increase in TFP thus creating net cross-state capital ownership positions. Net ownership positions converge to zero over time in the absence of further TFP movements. While TFP can not be directly observed, we can identify states with high TFP growth as states with high output growth. By comparing the level of personal income to output, we construct indicators of net capital flows into a state. We then examine empirically if the level of net capital flows between states following relative movements in TFP corresponds to the predictions of the model and whether net ownership positions tend to converge to zero. Our empirical results imply large flows of capital between states; for example, we find that a state with annual per capita output growth 1 percent higher than the average state over 10 years would attract capital in the amount of $9,900 per capita over those 10 years. These magnitudes are in close agreement with the predictions of the model. We conclude that frictions associated with borders are likely to be the main explanation for "low" *international* capital flows.

Keywords: regional net capital flows, ownership, dividend income, 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, 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, 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

Net capital flows between countries—or, equivalently, 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. Therefore, it is important to study the patterns of net capital flows between U.S. states, which have a common language, similar institutions, a common currency, and no legal barriers to capital flows. Deviations from several of these features are typically associated with national borders. We construct a simple frictionless neoclassical model, in which capital can freely flow between states and where total factor productivity (TFP) varies across states and over time.

The model delivers predictions regarding the magnitude of net 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. We find that our empirical results 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 net capital flows. Our paper complements studies of risk sharing: the extent of risk sharing depends, at least partly, on the degree of diversification of *gross* capital flows, while the focus of the present study is on the allocation of *net* capital flows.

Relatively small international capital flows have many manifestations such as low international portfolio diversification, low risk sharing, divergent real interest rates, etc. Most directly related to our work is the finding of a high correlation of saving and investment, relative to theoretical benchmarks, known as the Feldstein and Horioka (1980) puzzle. Obstfeld and Rogoff (2000) refer to this as one of the most robust and intractable puzzles in international finance.[1] The Feldstein-Horioka puzzle does not seem to be present for regions within countries, consistent with national borders being synonymous with frictions to net capital flows in the broad sense, but low investment-saving correlations is a rather

[1] These patterns are getting weaker, in particular, for countries in the European Monetary Union (EMU). Blanchard and Giavazzi (2002) discuss how the current account deficits of Portugal and Greece have recently increased in a manner consistent with systematic net inflows of foreign capital to finance investment.

weak test of neoclassical theory (for example, measurement error could render investment-saving correlations low in regional data).[2] Glick and Rogoff (1995) model the impact of TFP changes on the current account and investment. Taking their model to the data, they find, for the sample of large ("G-7") countries, that current accounts react to TFP movements as predicted by theory;[3] however, gross investments react much stronger than current accounts which is not consistent with the predictions of their model.[4]

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.[5] 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, capital will flow to states that experience a relative increase in TFP and, second, net capital income flows (or, equivalently, net ownership positions) 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 Gross Domestic Product (GDP), where GDP measures the gross (pre-depreciation) value of *output produced* physically within

[2]van Wincoop (2000) investigates the Feldstein-Horioka puzzle for Japanese prefectures and reviews studies of other federations. Sinn (1992) shows that the puzzle is not present for U.S. States using data—available for 1953 and 1957—from Romans (1965). van Wincoop points out that low regional level investment-saving correlations could be due to noisy data.

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

[4]Lucas (1990) points out that the simplest neoclassical model with constant TFP is strongly at odds with the data when comparing rich and poor countries since capital, if anything, seems to flow from countries with little capital to countries with more capital. Clearly, models with non-constant TFP are called for. 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.

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

each state.[6] In other words, states with relatively high TFP growth can be identified as states with relatively high output growth. It is important for this identification that there are no barriers to capital flows between states because then the relative amount of physical capital installed in a state is a function of the TFP level—contrary to the case of a closed economy where a country's investment is determined by its saving. We stress that the situation where capital freely flows between states is very different from the situation in a closed economy where the accumulation of physical capital is determined by the level of domestic savings. In the case of U.S states, the savings of (say) Californians not only increase California's growth but also the growth of all other states since those savings are invested in U.S.-wide capital markets.

A state that receives capital on net experiences an increase in liabilities (or decrease in assets). Assets and liabilities are also not observed at the state level but because a high level of liabilities is associated with a high level of (net) payments of dividends (or other forms of capital income) to other states, we can identify states with large net liabilities as states with low levels of income relative to output. More precisely, we use the ratio of output to income as an indicator of past net capital flows and current net capital income flows.[7] In our empirical analysis, we use several different specifications in order to address the backward looking nature of the output/income ratio as an indicator of past net capital flows.[8]

In the country-level national accounts, GDP plus net income receipts from abroad is denoted 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.[9] We use personal income ("income") as our base

[6]We often refer to state-level GDP simply as "output" and, for brevity, leave out the words "per capita."

[7]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 of interest are not observed. Previously, Atkeson and Bayoumi (1993) used this method for U.S. states.

[8]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.

[9]The state-level "national" accounts only report GDP numbers, so by "state-level GNI" we mean the

approximation to GNI in our empirical work.[10]

The implications of our model can be tested by examining the relation between the change in the output/income ratio (a measure of current capital income outflows and, therefore, an indicator of past net capital inflows) and past output growth (an indicator of TFP increases). The model predicts a positive relationship between these two variables. To investigate this we perform two sets of regressions. Our first set of regressions examine whether states with relatively high *growth* in the 1980s experienced an *increase* in the output/income ratio in the 1990s as predicted by the model.[11] These regressions provide the most direct test of the implications of our model.

Relative levels of TFP are likely to be very persistent—some states have relatively high output per capita for many decades. However, if TFP levels are persistent for decades then states with recent (but pre-sample) high growth can be identified as states with current high *levels* of output. The opposite is also possible: if there were barriers to capital flows between states in the past, then some states would have had low capital due to low savings—such states typically have low output. If such barriers have become less severe in the more recent past, we would expect to see capital flow to such low-output states rather than to high-output states. The latter scenario is less likely to be found for U.S. states but 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. Our second set of regressions, therefore, examine whether the *level* of the output/income ratio is relatively high for states with high *levels* of output.

The regressions of *changes* in the output/income ratio are strongly in accord with the

GNI numbers that would be produced by using the same methodology and data categories (if they were available) for states as those used in the country level national accounts. GNI was previously denoted Gross National Product, but the name was changed to reflect that the GNI of a country refers to income of that country, wherever earned, rather than production within the country. See Appendix A for a precise definition.

[10]We do not measure profits, interests, etc., as they accrue to corporations but, rather, the income that it ultimately generates to individuals. For example, if a large oil company is based in Texas and earns profits based on an increase in oil exploration in Alaska, we observe an increase in the output of Alaska, but 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.

predictions of our model. 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. Similar to what is often observed at the country level, capital does flow from poor to rich states, where rich states are those who exhibit high output due to high TFP. This is perfectly consistent with theory in a world of integrated capital markets, although this implication *need* not always hold.[12]

We examine whether the direction of capital income flows is persistent over very long periods by including in the level regressions relative dividend income in the 1940s. We find that state-level dividend income 50 years ago still helps predict today's output/income ratio. We also examine whether indicators of TFP, such as oil endowments, human capital, etc. help predict the output/income ratio and whether our main results are robust to inclusion of such regressors. We find that most of these regressors have little impact on the change in the output/income ratio from the 1980s to the 1990s, but that most of them have significant, intuitively reasonable, effects on the level of the output/income ratio. For example, states with a high fraction of retirees have a relatively low output/income ratio.

Because we do not directly observe GNI at the state level, it is essential to examine if our results are sensitive to how we approximate it. We show that our main conclusions are robust to various adjustments to personal income that may bring the data closer to GNI (at the cost of potentially adding noise). For example, income data includes transfers and we show that our main results are unchanged if we control for federal transfers to states. The income data for U.S. states also includes commuters' income from cross-border commuting and such income is important for a few states. The data allows us to disentangle commuters' inter-state labor income flows from total income flows and we show that our results are also not driven by commuters' income. Moreover, we obtain similar results when we impute GNI more directly by including income of state governments such as corporate

[12]The finding of a positive coefficient at the country level is regarded as a "paradox" because it contradicts the open-economy Solow model with integrated capital markets and constant TFP.

taxes and interest on trust funds, excluding all forms of federal transfers, and allocating aggregate corporate saving to states.[13] As an independent test of robustness, we consider 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. We find that the qualitative implications of our results also hold for his data. For example, 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.

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 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.

Consider 50 U.S. states, indexed by $i = 1, 2, ..., 50$ (for now, we suppress the time index t) each having a simple Cobb-Douglas production function

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

[13] 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 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.

In what follows, the allocation of capital across states is determined by TFP, i.e., A_i.[14] In order to stress that the allocation of capital as a function of relative levels of TFP, we can write the production function as

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

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.[15] 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*.[16] 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

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

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,

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

[14] 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.

[15] 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.

[16] The assumption that the U.S. 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.

and the GDP/GNI ratio is

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

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 Ownership Dynamics

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 $GDP = \Sigma GDP_i = N\, GDP_i$ and $R\,K = N\, RK_i = N\, \alpha GDP_i$. We have

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

and, therefore,

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

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.

Now introduce the time index t. If we assume that states have an identical saving rate s and the rate of depreciation is δ then

$$\phi_{it+1} = \frac{s\, GNI_{it} + \phi_{it}(1-\delta)K_t}{K_{t+1}}\ ,$$

which follows from the asset accumulation equation $K_{t+1} = I_t + (1-\delta)K_t$, where I_t is gross investment in time t. (This implies that the amount of capital owned by state i in period $t+1$ is $\phi_{it+1}K_{t+1} = sGNI_{it} + (1-\delta)\phi_{it}K_t$, where $sGNI_{it}$ is the gross saving of state i.) Note that

$$\frac{\phi_{it+1}}{\phi_{jt+1}} = \frac{sGNI_{it} + \phi_{it}(1-\delta)K_t}{sGNI_{jt} + \phi_{jt}(1-\delta)K_t}\ .$$

Divide numerator and denominator by $GDP_t/N = GDP_{it} = GDP_{jt}$ and get

$$\frac{\phi_{it+1}}{\phi_{jt+1}} = \frac{s\,(1-\alpha+N\phi_{it}\alpha)\; +\; N\phi_{it}(1-\delta)K_t/GDP_t}{s\,(1-\alpha+N\phi_{jt}\alpha)\; +\; N\phi_{jt}(1-\delta)K_t/GDP_t}\ .$$

It follows that if $\phi_{it} > \phi_{jt}$, then

$$\frac{\phi_{it+1}}{\phi_{jt+1}} < \frac{\phi_{it}}{\phi_{jt}}\ ,$$

i.e, the ratio of the ownership shares converges towards unity as long as $\alpha < 1$ and $\phi_{it} > 0$.[17] As long as production involves labor, a constant saving rate implies that the ownership shares, in the absence of TFP movements, converge to unity or, equivalently, net capital income flows converge to zero. However, if the saving rate out of wage income is zero, the ratio never converges to unity. And if the saving rate out of capital income is much higher than from labor income, convergence may be slow.

In order to get a quantitative impression of the speed of convergence, 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 the (arbitrary) value 1.023 in the initial period. Figure 1 shows the speed of convergence when $\alpha = 0.33$, the saving rate is 15 percent, and the depreciation rate is 5 percent. As can be seen from the graph, the model implies a half-life of 20 years.

2.2 Productivity Differences

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

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

[17]Let $x = sN\alpha + N(1-\delta)K_t/GDP_t$. Note that

$$\frac{\phi_{it+1}}{\phi_{jt+1}} = \frac{s(1-\alpha)+\phi_{it}x}{s(1-\alpha)+\phi_{jt}x} < \frac{\phi_{it}}{\phi_{jt}}$$

is equivalent—by multiplying both sides of the inequality sign by the denominators—to $s(1-\alpha)\phi_{jt} + \phi_{it}\phi_{jt}x < s(1-\alpha)\phi_{it} + \phi_{jt}\phi_{it}x$ which is equivalent to $s(1-\alpha)\phi_{jt} < s(1-\alpha)\phi_{it}$, which is the case when $\phi_{it} > \phi_{jt} > 0$, $s > 0$, and $\alpha < 1$.

Given $RK = \alpha GDP$,

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

or

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

A state with TFP, A_i, higher than average has K_i higher than average and therefore a value of output, GDP_i, higher than average. From equation (1), it is clear that the model implies that for *given ownership shares* a higher level of output is associated with a higher output/income ratio.

In order to evaluate the order of magnitude of changes in the output/income ratio following a productivity increase, assume that states initially (period 0) are in steady-state with $\frac{GDP_{i0}}{GNI_{i0}} = 1$, and that states have similar output $GDP_{i0} = GDP_0/N$. Consider the case of an increase in productivity in state i with no change in other states. (Our empirical work consists of cross-sectional regressions that includes a constant. In such regressions, only relative differences between states affect the results and we model relative changes by considering changes in just one state.) We have

$$\Delta(GDP_{i1}/GNI_{i1}) \ = \ GDP_{i1}/GNI_{i1} - 1 \ = \ \frac{GDP_{i1} - \alpha GDP_1/N - (1-\alpha)GDP_{i1}}{\alpha GDP_1/N + (1-\alpha)GDP_{i1}} \ ,$$

which implies:

$$\Delta(GDP_{i1}/GNI_{i1}) \ = \ \frac{\alpha(GDP_{i1} - GDP_1/N)}{\alpha GDP_1/N + (1-\alpha)GDP_{i1}} \ . \tag{2}$$

Approximately, aggregate output is unchanged so that $GDP_1/N \approx GDP_{i0}$ and therefore

$$\Delta(GDP_{i1}/GNI_{i1}) \ \approx \ \frac{\alpha(GDP_{i1} - GDP_{i0})}{GDP_{i0}} \ = \ \alpha \Delta \ln GDP_{i1} \ . \tag{3}$$

The interpretation of equation (3) is that to a first approximation all new capital, following a productivity increase, comes from other states and the return to capital subsequently goes to other states. The change in the output/income ratio is, therefore, approximately equal to the capital share times the growth rate of output.

2.3 Extensions of the Model

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 flows across U.S. states. 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. 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 do not claim that the simple model is the full truth and we abstain from trying to estimate the parameters of the model structurally. Rather, we estimate a linear specification which we amend with additional regressors for the purpose of examining intuitively reasonable extensions as well as robustness. With that in mind we discuss potential departures from our model.

- *What if capital flows to regions with low K rather than high A?* Our model is based on fully integrated regions where the capital/labor ratio is determined by total factor productivity ("A"). In the U.S., capital has been free to flow across state borders for at least a hundred years. 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.

- *Labor productivity convergence.* 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. If such convergence 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.)

- *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. Human capital investment would be included in capital, K, in our simple model. (Human capital stocks that do not result from investment in schooling or training would correspond to a change in TFP.)

- *Life cycle savings.* 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.

- *Migration.* 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).[18] 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

[18] 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.

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).

- *Agglomeration.* If agglomeration determines TFP then capital will flow to states where there are agglomeration benefits. From our model, an increase in TFP leads to an increase in the output/income ratio equal to $\alpha \, \Delta \log GDP$. 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.

- *Oil Price Shocks.* 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.

- *Natural endowments* of oil or fertile soil are likely to affect the output/income ratio. 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.

- *Agriculture.* 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).

- *Forward looking saving behavior.* Forward looking consumers, according to permanent income theory, 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. Such behavior would affect the predicted impact of TFP movements on the output/income ratio: for example, an increase in TFP in a state which signals future TFP increases would signal future higher labor income in this state.[19]

- *Stochastic TFP shocks.* 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.

- *Rate of Return Differentials.* In equilibrium, the ex ante rate of return to investment is same across the U.S. because the lending rate is the same—at least in the absence of risk premiums. 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* of flows would not be reversed and the magnitude of capital flows in response to TFP shocks would likely not be

[19]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 between past growth and the output/income ratio is due to this effect. However, this effect is not likely to be large because the state level evidence shows that current state-specific income growth only *weakly* predicts future state-specific income growth, see Ostergaard, Sørensen, and Yosha (2002). (Of course, we cannot rule out that 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, any effect would come only from labor income because capital income comes from all over the U.S. when capital markets are integrated. Therefore, the direction of capital flows would still be in the direction suggested by the model with a fixed saving rate

strongly affected by risk premiums even if the overall *level* of capital would be lower. In any event, we find it hard to imagine that there are significant differences in state-level risk premiums—and they would not likely cause *systematic* bias even if there were.

- *Uncertainty and risk sharing.* If returns to capital in different states are *ex post* random, gross capital flows may be determined by risk sharing considerations. However, agents typically hedge against risk by diversifying their portfolios, as is implicit in our bench-mark model, and this should not lead to particularly large *net* positions. (Such hedging would, of course, also diminish any systematic risk premiums.) In the data, we will not observe perfect risk sharing because labor income typically is not diversified.[20] Asdrubali, Sørensen, and Yosha (1996) find that 40 percent of state-specific GDP shocks are smoothed on interstate capital markets—this share is higher than capital's share of income, but not by much.

- *Foreign investment in U.S. states.* 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.)

3 Data

We use data from the Bureau of Economic Analysis (BEA) unless otherwise stated.[21] Urban population, number of college graduates by state, and migration data are from the Census Bureau. Oil prices are from the Energy Information Administration in the U.S. Department

[20]This is not literally true because corporations often smooth wages across production units which is a form of interstate risk sharing of labor income. (Budd and Slaughter (2000) find that such behavior is important even across international borders.)

[21]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).

of Energy. All nominal variables are converted into 2000 prices.[22]

State-level GDP is denoted Gross State Product (GSP) and published by the BEA as part of the U.S. state-level National Accounts. GSP is derived as the sum of value added originating in all industries in the state, thus, it is exactly the state-level equivalent of GDP; see Beemiller and Downey (2001).[23] GSP is available for the years 1977–2000.[24]

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 personal income to GDP in the aggregate U.S. National Income and Product Accounts (NIPA) in Appendix A. 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 the model 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, which will likely have a noticeable effect on aggregate state-level data. In our robustness checks in Table 7, we show results using this series for income. Another simple modification that we explore is to adjust the 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.

Finally, we constructed an approximation to state-level Gross National Income by using the variable "State Income," constructed by Asdrubali, Sørensen, and Yosha (1996). (We updated their numbers to include 1991–1999.) Conceptually, State Income equals GSP minus corporate retained earnings (including capital depreciation) plus net factor income

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

[23]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.

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

plus federal non-personal taxes imputed to states.[25] 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.[26]

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.

4 The output/income ratio: U.S. states, 1977–2000

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:

$$\text{OUT/INC}_{it} = \frac{\text{GSP}_{it} \,/\, \text{SPI}_{it}}{\text{GSP}_t \,/\, \text{SPI}_t}\,, \tag{4}$$

where:

$$\text{SPI}_t = \Sigma_i \,\text{SPI}_{it} \quad , \quad \text{GSP}_t = \Sigma_i \,\text{GSP}_{it}\,. \tag{5}$$

[25]State Income is calculated starting from the BEA data for personal income, which is pre- personal income tax but post- all other federal taxes as well as post- social security contributions and transfers. Therefore, to calculate State Income, add to the BEA personal income figures personal and employer social security contributions, and subtract social security transfers. Also 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 state public goods. Finally, add the interest revenue on the state's trust funds. The resulting number is (ceteris paribus) what 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. 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.

[26]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.

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

4.1 Time Series Plots

Figure 2 shows 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.

Figure 3 displays the output/income ratio for the eight regions. The figure 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.[27] 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.[28] 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. Some direct evidence is available: in Table 9 in Appendix B, we display "current account" numbers 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). Those direct 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. The correlation across states of Investment *minus* Saving averaged over those two years with the average value of the output/income ratio (1980–2000) is 0.22, consistent with the current output/income ratio being caused by previous capital inflows.

The large changes in oil prices that occurred during the period 1973–74 and 1979–87 are clearly visible in Figure 3. 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

[27]The findings are in line with Atkeson and Bayoumi (1993) who calculate a similar ratio for various U.S. regions for several sub-periods. They conclude that the northeastern regions supply capital to other U.S. regions, but they do not pursue the issue of *why* some regions supply capital to others.

[28]See North (1961).

1970s and then declines steeply in the years following the Iranian revolution in 1979 while the dispersion of the output/income ratios falls rapidly around 1987 to a lower level than before.

The output/income ratio seems to converge over time. In the graphs, a compression is visible in the mid 1980s and this timing may have to do with movements in oil prices around this time—at least for the Southwest region. However, the longer-run compression does not, in general, move with energy prices. One significant change in the output/income ratio relative to other regions is found for the Great Lakes region which saw a steady decrease throughout the 1960s and 1970s moving from above to below average.[29] 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 what our model would predict conditional on the growth patterns displayed in Figure 2: 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, according to our model. 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.

Figure 4 explores directly if oil price spikes were reflected in changes in the output/income ratio for states with high output of oil ("oil-states"). We plot the average world price of crude oil and the output/income ratio for the oil-states Alaska, Louisiana, and Wyoming for the years 1963–2000. There is a clear 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

[29] 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.

factor income from those oil states.

Overall, the time series patterns are highly consistent with the implications of our model.

4.2 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 recent output *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 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 *current output* and other regressors. 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. To proxy for current output, we therefore use as a regressor the variable "output 1977-80" which is calculated as the log-level of per capita GSP averaged over the four years prior to the years used for measuring the output/income ratio. The averaging removes most short-term business cycle effects which, for the purpose of this paper, are equivalent to measurement error.

Our model predicts that ownership patterns persist for decades. The BEA data is not available for a very long period so, 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 "historical dividend and interest income"—the per capita average value of dividend and interest income by state. We calculate the log-average of the period 1939–49. 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, except that the coefficient to this variable is smaller if we use the data from the 1930s.[30]

We now describe other variables that we include in our empirical work, partly to examine robustness of our results, and partly to examine intuitive extensions of our model discussed earlier.

Retirees. 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. *Migration/* might affect the output/income ratio. We add as a regressor the rate of net inter-state migration as a percent of state population in 1975−1980.[31] *Geography.* Historically, the northern states were the seat of U.S. industrialization and much wealthier than the South. We define a dummy variable, which we denote "north", that takes the value 1 for New England, Mid-East, and Great Lakes and 0 for other regions.[32] *Human Capital* endowment is measured as the number of college graduates in a state relative to population in 1989.[33] *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. *Natural endowments.* We do not observe the actual 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 the same years used for "Output" (1977-80). We also 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 second world war period. One reason might be that dividends were still paid out during the war years.

[31] 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.

[32] 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 2.

[33] This is the first available year for this variable.

4.3 Historical dividend and interest, growth, output, and the output/income ratio by state

In Table 1, 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 much 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 on the other hand also have a high output/income ratio, 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 income and dividend" variable less significant statistically but our main qualitative results are robust to the inclusion of this state.

4.4 Descriptive statistics

Table 2 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 2, 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.

4.5 Correlation between regressors

In Table 3, 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): states with high output/income ratios in the 1980s were the states with relatively low growth during this period. The other correlations are all below 0.50.

4.6 Cross-sectional regressions

Table 4 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). 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 Appendix B.

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 ten percent faster than the average state (one 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.[34] In Section 2, equation (3), 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 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. If the return to capital is (say) 10 percent, this implies that capital in the order of 9,900 dollars per capita was financed by other states. This is a large net capital inflow by most criteria.

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

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

a 10 year span the output/income ratio would have converged to a value of 1.012.[35] This estimated value corresponds roughly to what would be expected from Figure 1.

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 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.[36]

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 5, 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”

[35] 1.012 is found as 1.02+.02*(−.42), where 0.02 is the deviation from the average value of 1.

[36] Our cross-sectional regressions, in column (2), have the form of regressing the output/income ratio on its own lagged value 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 experimented with panel regressions for shorter time spans (using the specification of column (2)). We found that the coefficient to lagged growth was quite robust to shortening the time span while the size of the coefficient to the lagged output/income ratio declined. The coefficient to the lagged ratio measures how fast the output/income ratio would converge, ceteris paribus, during one period, to unity. The numerical decline in this coefficient is due to the shortening of the length of each period. The estimates still imply similar half-lives as before. Because these panel data regressions lead to similar conclusions as our cross-sectional regressions but the assumption of our model of no adjustment costs for capital becomes less reasonable for short time spans, we prefer to display only the cross-sectional regression results.

quite significantly. This may simply be due to recipients of federal transfers being more likely to live in rural areas.[37] 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.[38]

In column (4), we use a more elaborate approximation to GNI based on the "State Income" variable from Asdrubali et al. (1996). 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)—this variable is independently constructed and based on different data. Nonetheless, we find that "growth in 1980s" has explanatory power for this variable with the predicted effect; "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 which is somewhat smaller than the estimate obtained from Table 4. One might speculate that Duczynski's asset variables, which are based on dividend, interest, and rent income, may miss entitlement to capital income that are not directly tied to formal assets such as inter-company income flows, pensions, etc. and, therefore, underestimate actual net capital flows. We consider the broader income measures, used in this paper, to be more comparable to international GNI data. Further study of this issue will take us too far afield

[37] 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)].

[38] 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)].

but, importantly, the results based on these independent estimates are of similar orders of magnitude.[39]

Level regressions. Our main results for the level regressions are presented in Table 6. 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 Appendix B). 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.

From 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. 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, 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.

"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

[39] Duczynski's estimates are based on the sum of personal property income (dividends, interest, and rent). One problem with the rental income variable is that this type of income mainly derives from locally used and owned property and such income might have little to do with financial integration.

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 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.

Table 7 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 6. The smaller effect found using Duczynski's data is similar to what we found in the change regressions and have already been commented on. 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 Summary

We study net capital flows between U.S. states. In a simple neoclassical model 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 capital (on net) flows to states which experience relative increases in TFP. We find this prediction clearly confirmed by the data. Simple "back of the envelope" calculations reveal that such net capital flows 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.

Net capital flows 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 net 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 net 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.

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.

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.

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.

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 (say) 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.". Available at http://www.oecd.org/dataoecd/38/18/2674296.pdf and BEA (2003), "Preview of

the 2003 Comprehensive Revision of the National Income and Product Account", Survey of Current Business, June 2003; section:"Changes in Definitions and Classifications". Available at http://www.bea.gov/bea/ARTICLES/2003/06June/0603NIPArevs.pdf

Appendix B: Robustness

In Table 8, we display Investment minus Saving, or the "current account," for U.S. states in 1953 and 1957 as estimated by Romans (1965). It is immediately clear from inspection 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. In fact, the correlation of the average of the 1953 and 1957 Investment minus Saving numbers with the average output/income ratio (1980–2000) is 0.22. While this is somewhat unsystematic evidence, these observations, nonetheless, provides one more piece of evidence supporting our interpretation of the output/income ratio as tracing past net capital flows.

Table 9 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 6. (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 9, in terms of which regressors are significant.) The results of Table 9 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 10, we, in column (1), show the results for 50 states. It is interesting that the coefficient 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.

Table 11 considers our level specification across sub-samples. We find that the estimated impacts of "output 1977−1980", "historical dividend and interest income", and "retirement" are remarkably robust, while that of the "oil share" is highly significant in the 1980s but not in the 1990s. This pattern, however, is consistent with our model as discussed previously in relation to Figure 2. The high oil prices in the late 1970s acts like an TFP increase in oil states and such state attracted large investments in the late 1970s. During the 1980s, following the oil price bust, oil states were famously depressed and net capital flows reversed out of the oil states. The impact of oil on the output/income ratio in the 1990s then became insignificant as some capital investment from the 1970s were still being amortized while returns to new investment in non-oil states created countervailing capital income flows.

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; we use the earlier data for graphical illustration in Figures 2, 3 and 4, but not for regression analysis.

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 (www.energy.gov/engine/content.do) for 1968–2000.

Investment and Saving, 1953 and 1957: This data 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: **Descriptive Statistics**

	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 1: Average Data, State-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 and Interest Income are averages over 1939−1949. Output 1977−1980 is GSP per capita, averaged over 1977−1980. Growth in 1980s is the sum of the yearly growth rates of GSP per capita over 1980−1990. Output/Income is the GSP/SPI, averaged over 1981−2000. All in 2000 prices.

Table 2: **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. The 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 3: **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-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 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. The 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. "Output/Income in 1980s" is the log of average of the output/income ratio over 1981−1990. "Growth in 1980s" is the sum of the yearly growth rates of GSP per capita, over 1981−1990.

Table 4: **Determinants of the Change in Net Capital 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). The 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. Heteroskedasticity robust t-statistics in parentheses.

Table 5: **Determinants of the Change in Net Capital Flows: Other Measures of the Net Capital Flows**

	(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). The 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 text 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. "Output/Income in 1980s" is the log of the average of the output/income ratio over 1981−1990 in the first 3 columns and the average of the ratio in column 4. "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. Heteroskedasticity robust t-statistics in parentheses.

Table 6: **Determinants of Net Capital 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. Heteroskedasticity robust t-statistics in parentheses.

Table 7: **Determinants of Net Capital Flows: Other measures of Net Capital Flows**

	(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 text 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. Heteroskedasticity robust t-statistics in parentheses.

Table 8: **(Appendix) Investment minus Saving by State 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

Source: Romans (1965).

Table 9: **(Appendix) Determinants of Net Capital Flows: Robustness RHS**

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: First column includes Alaska, Hawaii, and Delaware. See Table 1 for detailed explanations of the variables. Heteroskedasticity robust t-statistics in parentheses.

Table 10: **(Appendix) Determinants of the Change in Net Capital Flows: Robustness RHS**

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: First column includes Alaska, Hawaii, and Delaware. See Table 1 for detailed explanations of the variables. Heteroskedasticity robust t-statistics in parentheses.

Table 11: **(Appendix) Determinants of Net Capital Flows: Sub-Periods**

Dependent Variable: Log of Output-Income Ratio

	(1)	(2)	(3)
Sample	1981−2000	1981−1990	1991−2000
States	47	47	47
Output 1977−1980	0.24	0.26	0.29
	(4.41)	(3.75)	(4.52)
Historical Dividend	–0.05	–0.05	–0.07
&Interest Income	(3.35)	(3.27)	(4.17)
Oil Share	0.54	0.90	0.17
	(3.47)	(4.84)	(0.91)
Retirement	–0.11	–0.11	–0.11
	(2.72)	(2.68)	(2.28)
R^2	0.76	0.82	0.66

Notes: See Table 1 for detailed explanations of the variables. Heteroskedasticity robust t-statistics in parentheses.

Figure 1: Convergence of Output/Income ratio following a positive productivity shock

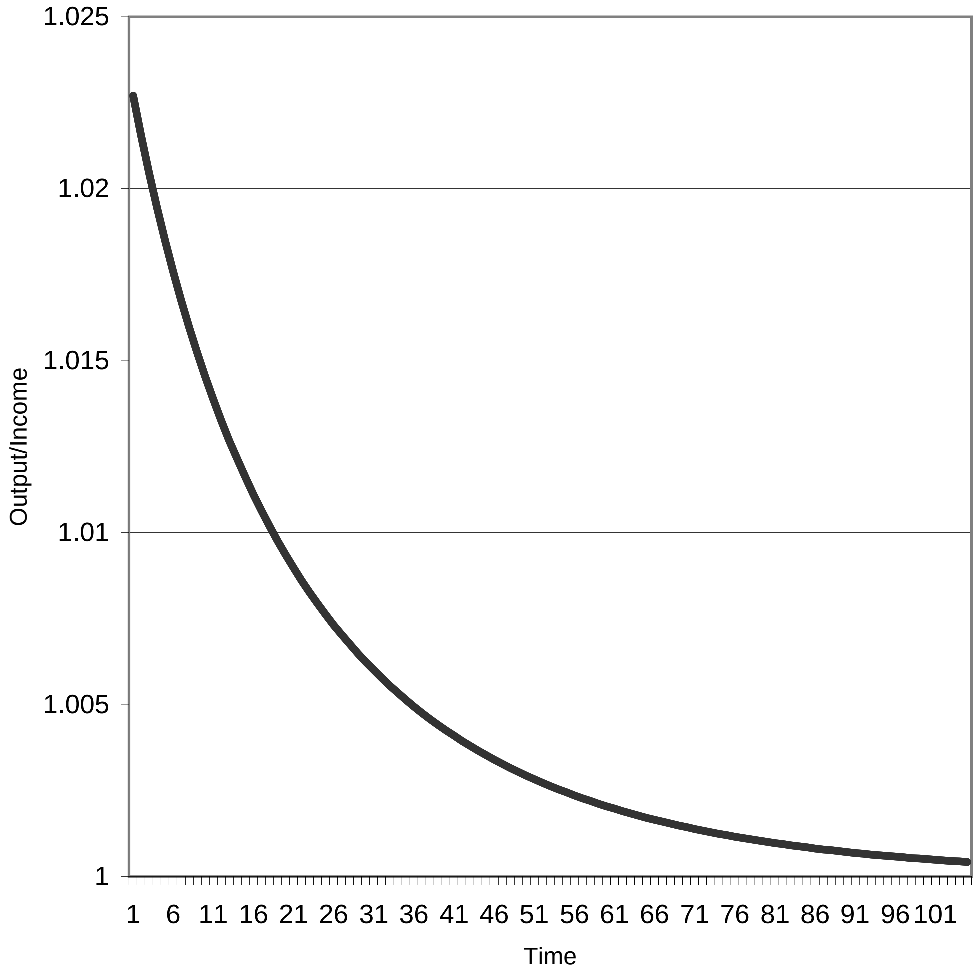


Figure 2: Growth of Real GDP per capita by regions

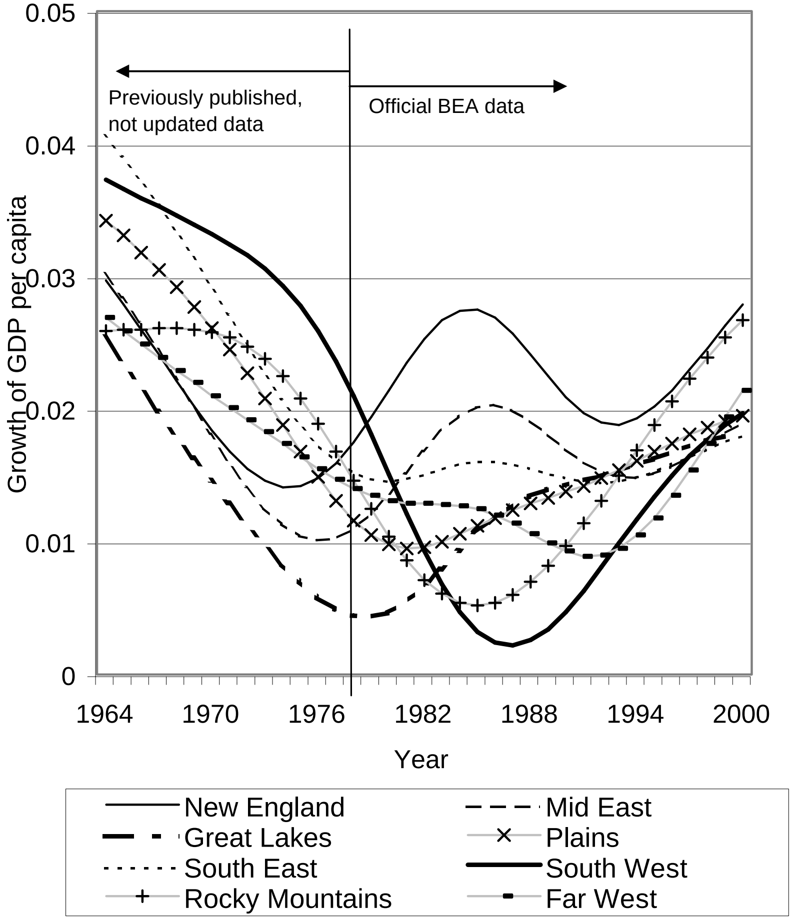
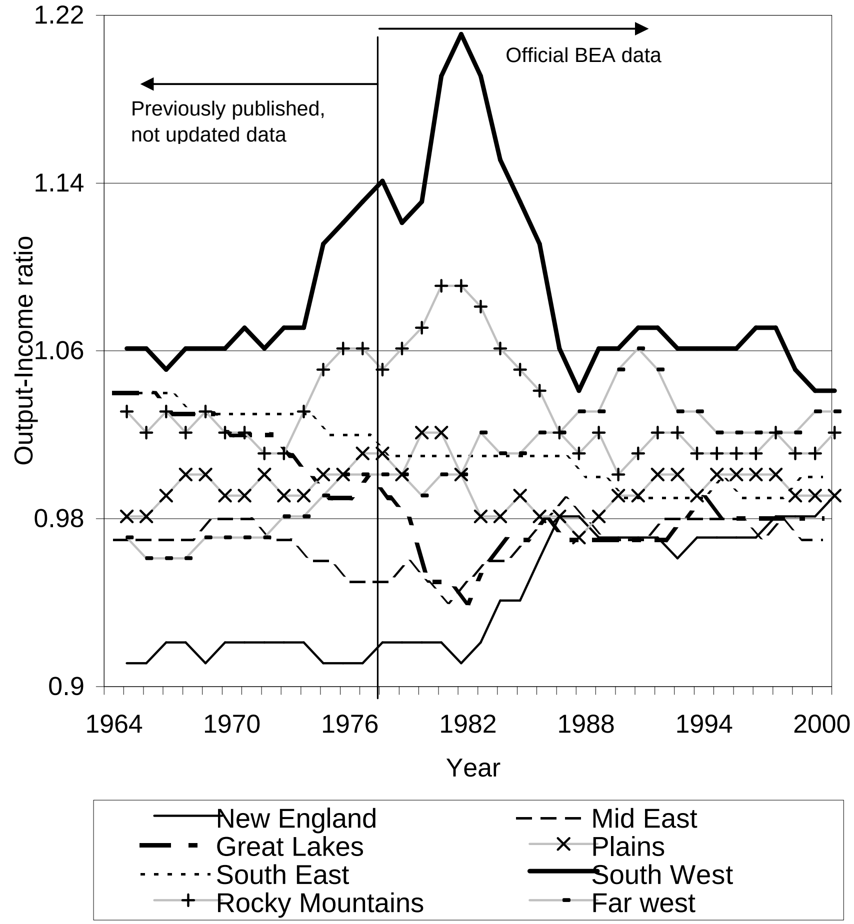


Figure 3: Output/Income ratio by regions



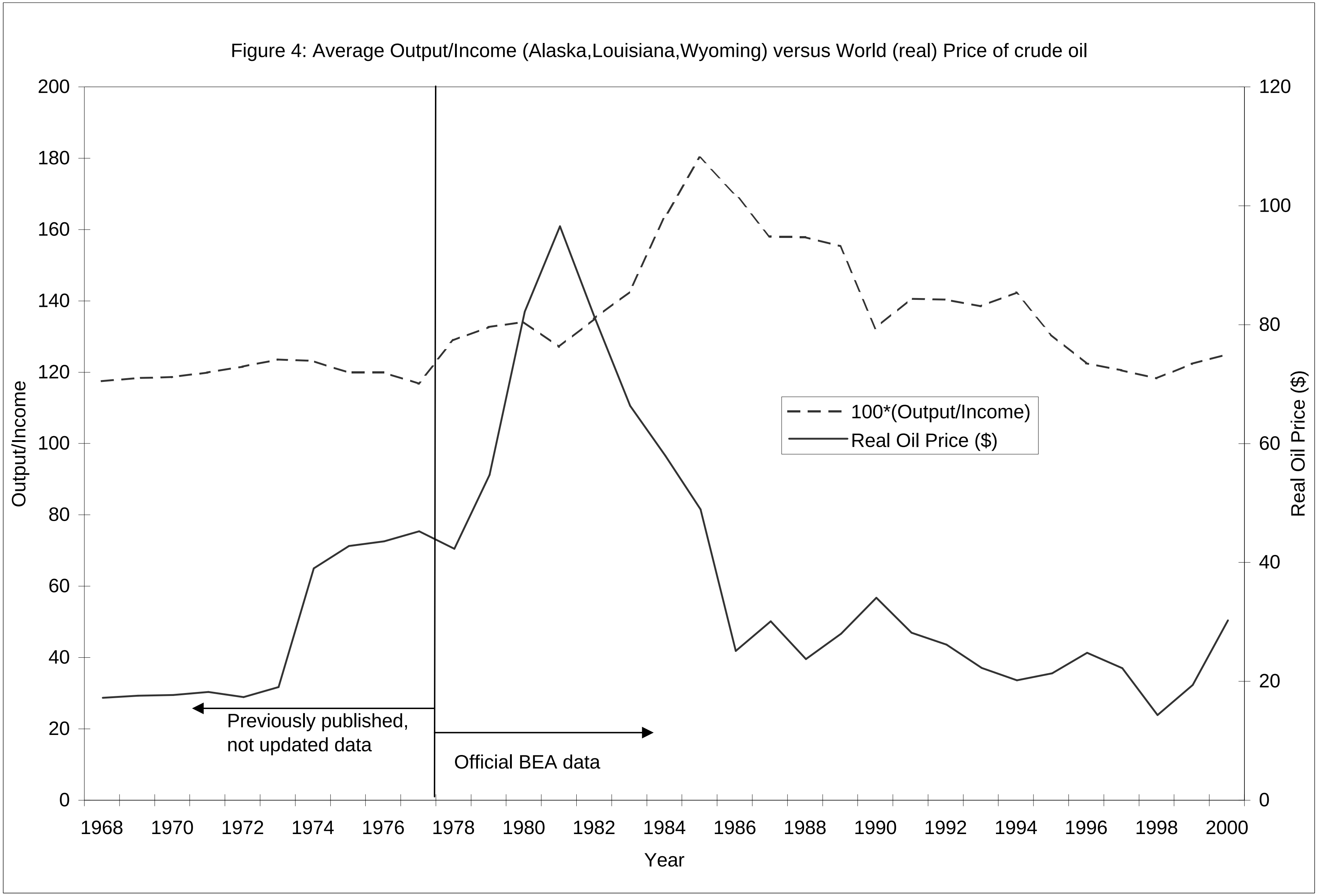


Figure 4: Average Output/Income (Alaska,Louisiana,Wyoming) versus World (real) Price of crude oil
Output/Income
Real Oil Price ($)
Year
100*(Output/Income)
Real Oil Price ($)
Previously published,
not updated data
Official BEA data
0
20
40
60
80
100
120
140
160
180
200
0
20
40
60
80
100
120
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000

Institute for International Integration Studies
The Sutherland Centre, Trinity College Dublin, Dublin 2, Ireland