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ABSTRACT

The literature has shown that the implied welfare gains from international financial integration are very small. We revisit the existing findings and document that welfare gains can be substantial under two scenarios: a) the costs of remaining in autarky are worse than the standard neo-classical model would predict, and b) financial integration has a direct affect on total factor productivity. By estimating the implied autarky path of convergence of rates of return from the actual data and calibrating the welfare gains based on this path, we find that the benefits are nearly 4.3 times larger than the previous estimates. We also find welfare gains are at least 2 times larger than estimates ignoring the productivity effect. The combined effect of realistic convergence and endogenous productivity as a result of financial integration is equivalent to a nearly 15% permanent increase in consumption for the average developing country.

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1 Introduction

How big are the gains from international financial integration? Given the crises of the emerging market countries after their liberalizations, and the current global financial meltdown, one wonders if there are any gains at all from international asset trade. Indeed, the literature so far has shown that the implied welfare gains from financial integration are very small.

How beneficial financial integration is for a country depends on the economic conditions it would face *without* integration. In this paper, we explore the two main assumptions used by the previous literature to describe this autarky situation: a) capital accumulation is usefully described by a neo-classical Ramsey model, and b) productivity is the same in autarky as when financially open.

There have been two approaches in the literature to quantify the welfare gains.[1] The first approach focuses on the risk sharing mechanism. International asset trade allows agents to pool idiosyncratic risk and smooth consumption. Starting with Lucas's work (1987), there is an extensive literature that shows, in a representative agent framework with transitory shocks, the welfare gains from consumption smoothing upon integration are very small. Lucas himself finds a welfare cost of fluctuations that is around 0.042% of average consumption. Although subsequent work showed that with permanent shocks and/or a feedback effect on industrial structure welfare gains via the risk sharing mechanism of integration can be as big as 20%, once calibrated to different countries the gains stay around 1% on average (Obstfeld (1994), Kalemli-Ozcan, Sorensen and Yosha (2001), and van Wincoop (1994)).

The second approach focuses on capital scarcity. This channel will work through reducing the cost of capital and accelerating capital accumulation and growth due to an influx of foreign capital. The key idea here is that for capital-scarce countries foreign capital will "fill in the gap" and help countries attain their steady-state. Gourinchas and Jeanne (2006) (GJ hereafter) are the first ones to have investigated the implied welfare gains of this channel. They find very small gains, 1.74% on average across their sample of developing countries. The basic problem is that although foreign integration accelerates the convergence to the steady-state, the convergence implied by the autarky neoclassical model is also so fast that the difference between integration and autarky is very small. Thus, financial integration does not provide much of a benefit. That is why GJ conclude that, even though countries may be far from the steady state, conditional convergence plays a minor role compared to productivity differences across countries in explaining the welfare gap between poor and rich, a result that is also consistent with the growth and development accounting literature (Hall and Jones (1999); Easterly and Levine (2001)).[2]

In this paper, we will also focus on the capital scarcity channel. We argue that welfare gains through this channel can be quite substantial once we change the two basic assumptions of the GJ's analysis. The first assumption is about the speed of convergence of the rate of return to capital to the steady state rate of return under autarky. To focus solely on the role of capital scarcity, GJ assumes that in the long run, the steady state rate of return on capital is exactly equal to the world rate, which could have been reached

[1] There is an enormous literature that tries to quantify the effect of financial integration on growth. See Kose, Prasad, Rogoff, and Wei (2009) for an extensive survey. We abstain from investigating the direct effects of finance on growth since it is not straightforward to convert the growth effects into welfare benefits.

[2] It will still be the case that gains are relatively larger for the countries that are farther away from their steady states.

immediately by financially integration. The welfare benefits of financial integration arise because it allows a country to "jump" to its steady state. In autarky the country would have to consume less in the present in order to build up their capital stock to the point that the return was equal to the world rate. With financial integration, foreign capital can flow in immediately to avoid this sacrifice of current consumption.

GJ calculate the implied welfare gains from opening up by comparing the autarky consumption path out of a Ramsey model to the path under a small open economy assumption, which boils down to comparing the time path of respective interest rates. This analysis yields small welfare gains because, under the Ramsey model, countries are converging very quickly to their own steady states, which is the assumed steady state under integration.[3] Hence even if there are large initial differences in rates of return, these will disappear very quickly *even in autarky*. Because of this, financial integration does not provide much of a benefit. The point we would like to emphasize is that the prediction of what would happen in autarky—the welfare costs of staying closed—is key to calculating the welfare benefits of integration.

Realizing this, GJ introduce frictions to the basic Ramsey model to slow down the implied path of autarky convergence, but still obtain small welfare gains. Here, we take an alternative approach, which is based on the observed data on rates of return. The question we ask is as follows: How can we evaluate the success of the neo-classical model for predicting the time path of rates of return under autarky? To do this, we will undertake the same analysis as GJ, but our start date will be the year 1960, rather than 2000 as they assume. The reason we do this is to compare the predictions of the neo-classical model for the autarky path of rate of return from 1960 forward to the actual observed rates of return in the data for the years 1960 to 2000.

What we find is that the predictions of the neo-classical model are far from matching what has been observed in the data. The Ramsey model predicts that 23% of the gap between the autarky rate and world rate closes each period, both in our case and in GJ. In contrast, regressions using data from 102 countries between 1960–2000 show that rates of return converge at less than 2% per year. To put it differently, the neo-classical model predicts that only 0.0017% of the original return differential from 1960 should remain as of 2000. In contrast, the data suggests that 67% of the original return differential still existed in 2000.

Using our estimated coefficient on the rate of convergence, we parameterize the autarky path of convergence. Evaluating the welfare gains from financial integration comparing this parameterized path to the world rate of return, we find that the benefits are nearly 4.3 times larger than the original estimates of GJ. Their welfare gain for an average developing country was equivalent to a permanent 1.74% increase in consumption, whereas with realistic convergence rates we estimate the welfare gain being closer to a 7.5% increase in consumption.

The second basic assumption of the GJ analysis that leads to small welfare gains is that total factor productivity is exogenous to the opening of the capital account. However, there is extensive evidence, both at the country-level (See Kose, Prasad, Rogoff, and Wei (2009)) and at the firm-level (Javorcik (2004)), that

[3] Note that this is different then the "instantaneous" convergence property of the neoclassical model criticized by many starting with the work of Barro, Mankiw, Sala-i-Martin (1995). "Instantaneous" convergence is the convergence of the interest rate to the world rate upon opening up immediately, which is the case both in GJ and here. The speed of convergence we are analyzing here is the one implied by the autarky optimal savings model, hence the one in the *absence* of integration.

foreign capital has effects on productivity itself, even holding constant the actual capital stock. Thus, in the second part of the paper, we estimate the welfare gains of financial integration if these productivity effects are accounted for, irrespective of the gains estimated in the first part, which are based solely on the increase in consumption that arises from the inflow of foreign capital.

To do this, we focus on one channel of foreign capital, foreign direct investment (FDI). The reason for this choice is as follows. The literature so far has established the growth effects of foreign capital, if any, will work through FDI. In addition to the direct capital financing it supplies, FDI can be a source of valuable technology and know-how while fostering linkages with local firms, which can help jump-start an economy. Domestic firms will be exposed to direct productivity gains, better managerial skills, enhancements to employee training, development of international production networks, and broader access to markets. When new products or processes are introduced to the domestic market by foreign firms, domestic firms may benefit from the accelerated diffusion of new technology. Consistent with these benefits and spillovers, Bonfiglioli (2008) finds that financial integration, measured mainly as FDI and equity flows, affect economic growth via productivity and not via capital accumulation.

The key to incorporating FDI productivity effects into our calculation is obtaining a well-identified estimate of the effect of FDI on the log of total factor productivity (TFP). The primary issue here is that foreign capital may flow to those countries or firms that already have high productivity, and therefore any estimated relationship of TFP with respect to FDI is potentially biased upward. In recent surveys, Obstfeld (2009) and Kose, Prasad, Rogoff, and Wei (2009) conclude that the macro-economic literature does not seem to find a robust significant effect of financial integration, measured either as FDI flows or total flows, on economic growth due to two main problems: 1) endogeneity and 2) country-specific benefits. The second problem is saying that the benefits of financial integration would only be present in countries with a minimum threshold level of financial sector development, institutional quality and macroeconomic policies. Given the endogeneity problem and the difficulties involved in measuring country-specific benefits, effects of FDI may not be easy to detect in macro data. Both surveys advise the use of micro data. Thus, to close in on the true relationship of FDI on TFP, we turn to firm-level studies from developing countries and those firm's response to foreign ownership. After examining a variety of studies, we found several (Arnold and Javorcik, 2005; Evenett and Voicu, 2003; Javorcik, 2004) that are able to achieve identification of this effect, and from these we derive our estimates of the elasticity of productivity with respect to FDI, in the exact same way done in growth accounting literature (Klenow and Rodrigues-Clare (1997)).

Incorporating these estimates, we find welfare gains at least 2 times larger than those estimated by GJ ignoring the productivity effect. It does not matter whether one accepts the original GJ estimate or our updated estimates with realistic rates of convergence, incorporating the FDI effect doubles the welfare from integration. This productivity effect is a lower bound given the fact that the micro estimates we use are only for the effect of FDI in the manufacturing sector. As a result, the combined effect of our adjustments mean that financial integration could be equivalent to a nearly $1.74\% \times 4.3 \times 2 = 15\%$ permanent increase in consumption.

The paper continues as follows. Section 2 summarizes the predictions of the Ramsey model in terms of welfare gains from letting in the foreign capital. Section 3 estimates the actual rate of convergence, and calculates the welfare gains using this estimated rate. Section 4 endogenizes productivity to the effects of FDI and calibrates the welfare gains based on this adjustment. Section 5 concludes.

2 Evaluating Welfare from Financial Integration

To measure the potential welfare gain from financial integration, we will follow the basic structure of the GJ analysis. These authors compare the utility of the consumption path a country would enjoy if it were completely financially integrated to the utility of the consumption path if that country were to be completely autarkic. They use the neo-classical model of optimal savings (the Ramsey model) to describe how consumption would evolve in both cases. Under standard assumptions regarding the utility function (constant relative risk-aversion) and the production function (Cobb-Douglas with exogenous growth rates of population and total factor productivity) they solve for the optimal path of consumption under a) full financial integration, and b) complete autarky.

Under financial integration, capital immediately flows in (or out) of a country until the domestic rate of return falls (or rises) to match the world rate of return, R^w. From that point forward, consumption in the country grows at a rate dictated by the Euler equation, as in

$$c_{t+1} = (\beta R^w)^{1/\sigma} c_t \tag{1}$$

where β is the time discount factor and σ is the coefficient of relative risk aversion. At the moment of integration, the level of consumption jumps up as domestic agents enjoy either an increased wage (if foreign capital flowed in) or an increased return on assets (if domestic capital flowed out). Initial consumption upon integration can be found from the dynamic budget constraint (see appendix equation (31) for details) as R^w dictates the level of capital and output upon integration. The utility of this consumption profile can be denoted

$$U^{int} = \sum_{t=0}^{\infty} \beta^t u(c_t^{int}) \tag{2}$$

where c_t^{int} is the path of consumption under integration. A full description of this calculation can be found in the appendix A.

In autarky, the capital stock is determined completely by domestic savings. The rate of return on capital will vary over time as a country converges towards its steady state. As mentioned in the introduction, to focus solely on the role of capital scarcity GJ assume that, in the long run, the steady state rate of return on capital is exactly equal to R^w. What this means is that in autarky, a country will *eventually* have exactly the same capital stock that they could have *immediately* by financially integrating. The optimal path of the capital stock can be extracted from a linearized version of the Ramsey model,

$$\hat{k}_{t+1} = p\hat{k}^w + (1-p)\hat{k}_t \tag{3}$$

where $\hat{k}$ is capital per efficiency unit, $\hat{k}^w$ is the steady state value of the capital stock, and $p \in (0,1)$ is determined by the fundamental parameters of the Ramsey model.[4]

The optimal path of consumption in autarky can be extracted from the dynamic budget constraint given the path of the optimal capital stock. The utility of this consumption profile is denoted

$$U^{aut} = \sum_{t=0}^{\infty} \beta^t u(c_t^{aut}) \tag{4}$$

where c_t^{aut} is the optimal consumption path.

To evaluate the welfare gain of financial integration, GJ compare the utility under the two scenarios. They calculate the Hicksian variation, or the percent permanent increase in consumption that is equivalent to the difference between financial integration and autarky. This is measured as

$$\mu = \left(\frac{U^{int}}{U^{aut}}\right)^{1/(1-\sigma)} - 1 \tag{5}$$

and as GJ note, utility under financial integration must be higher than utility under autarky given the first welfare theorem. Therefore, μ will be positive.

As a result, financial integration is beneficial since it allows a country to "jump" to its steady state. In autarky the country would have to consume less in the present in order to build up their capital stock to the point that the return was equal to R^w. With financial integration, foreign capital can flow in immediately and avoid this sacrifice of current consumption. There is a "cost" of integration, of course. A country receiving inflows of foreign capital will have to pay this back with lower consumption levels in the long run. But because of time discounting, on net there is a gain in utility.

Calculating a specific μ requires picking exact values for the parameters of the neo-classical savings model (relative risk aversion, time discount rate, long-run growth rate of total factor productivity, depreciation, population growth) as well as determining the size of the initial domestic capital stock. According to GJ's calibration μ is relatively small. For the average non-OECD country, they find a welfare gain of integration of only 1.74%. Let us turn to the details of this calibration and try to understand why this is such a small number.

2.1 Autarky, Convergence, and Welfare

Why are the gains of financial integration so small? The speed at which a country in autarky is assumed to reach its steady state is very fast, irrespective of the initial position of the country. What GJ find is that countries are converging so quickly to their own steady states that the initial differences in rates of return will disappear very quickly *even in autarky*. Because of this, financial integration does not provide much of a benefit. This holds even if there is a large existing difference between the domestic rate of return and the world rate.

[4] Appendix A derives the exact value of p in the same manner as Barro and Sala-i-Martin (2004).

To see this more clearly, consider the following alternate explanation of the value of μ from GJ. Imagine a marginal increase in financial integration for a country. The country authorizes additional foreign capital in the amount $d\kappa_{t+1}$ at time t. This increases domestic output by the amount $d\kappa_{t+1}R_{t+1}$, where R_{t+1} is the marginal product of capital in the country. At the same time, the foreign investors must be compensated for the use of their capital at the rate R^w, the world rate of return. The net gain in income is therefore $(R_{t+1} - R^w)d\kappa_{t+1}$. The welfare benefit of this increased income can be written as:

$$dU_{t+1} = u'(c_{t+1})(R_{t+1} - R^w)d\kappa_{t+1} \tag{6}$$

where $u'(c_{t+1})$ is the marginal utility of consumption in period $t + 1$. With log utility, this becomes

$$dU_{t+1} = (R_{t+1} - R^w)\overline{\kappa} \tag{7}$$

where $\overline{\kappa} = d\kappa_{t+1}/c_{t+1}$ is the ratio of capital flows to current consumption. Allowing capital flows so that $\overline{\kappa}$ is constant in every period, the discounted utility gain of these capital flows is then

$$dU = \sum_{t=0}^{\infty} \beta^t (R_{t+1} - R^w)\overline{\kappa}. \tag{8}$$

As mentioned above, the value μ captures the percentage permanent gain in consumption equivalent to the welfare gain of financial integration. This welfare gain, therefore, can be represented as

$$dU = \sum_{t=0}^{\infty} \beta^t \ln(1 + \mu) \tag{9}$$

again assuming log utility. Now, if we assume that μ is relatively small so that $\ln(1 + \mu) \approx \mu$, and solve together (8) and (9), we have

$$\mu \approx \beta \left(\hat{R} - R^w\right)\overline{\kappa}. \tag{10}$$

where the value $\hat{R}$ is defined as follows:

$$\hat{R} \equiv (1 - \beta) \sum_{0}^{\infty} \beta^t R_{t+1}. \tag{11}$$

This represents the discounted value of the domestic rate of return *under autarky.* It is not simply the current gap in rates of return that matters for whether integration is beneficial. The time path of the rate of return in autarky matters as well. GJ solves for this using the Ramsey model of a closed economy to obtain the path of capital per efficiency unit and hence the path of the return on capital, R_{t+1}.

To calculate the path of R_{t+1} requires information on the long-run parameters of the economies. The time discount rate and the growth rate of total factor productivity (TFP) are essential, as they dictate the steady state value of the rate of return. Regarding the time discount rate, GJ assume that it is equal to

$\beta = 0.96$, and the long-run growth rate of TFP is equal to the long-run U.S. growth of 1.2% per year. What this implies is that the steady state rate of return is equal to 5.42%. By assumption, the world rate is equal to 5.42% as well.[5]

Using these long-run parameters and data from the year 2000 on capital stocks for initial values, GJ calibrate the path predicted by the neo-classical model for rates of return. The data on the initial capital stock per capita (k_0) and TFP (A_0) are obtained from Bernanke and Gurkaynak (2001) using investment and output data from the Penn World Tables. What they find is that the value of $\hat{R}$ is very small, and thus the implied welfare gain from integration is small as well.

GJ note that their results are due in large part to the fact that the neo-classical model predicts very fast convergence under autarky. They expand their baseline model to incorporate human capital accumulation and explicit frictions in both physical and human capital accumulation in order to "slow down" the convergence of the rate of return to the world rate under autarky. This implies a larger sacrifice of current consumption to reach the steady state, and therefore more benefits out of financial integration. Figure 1 compares these two different paths. The rate of return over time is plotted under different assumptions. For a country that integrates at time zero, the rate of return instantly drops to R^w, and remains there forever. The autarky path of the rate of return in GJ's baseline model (curve A) begins at R_0 and then quickly drops over time towards R^w. From equation (10), we know that the welfare gain of integration is related to the area between this curve and the flat line at R^w, suitably discounted.

With frictions, this increases the time that a country in autarky will take to reach R^w, as denoted by curve B of figure 1. Thus the area between curve B and the flat line at R^w is larger, and therefore the welfare gain of integration is larger. However, even with these frictions in autarky, GJ find that the implied welfare gains are small.

2.2 Observed Rates of Return

We have shown so far that the determination of the welfare gains of integration depends crucially on the assumed path of the rate of return *in autarky*. What we want to ask is whether these assumed paths, which are shown in figure 1, are actually realistic. The answer will be no, since as we show below the data implies a convergence path that looks like curve C in figure 1.

To do this, we note that the while GJ performed their calculations using observed data in the year 2000 to establish initial values, there is nothing about their process that precludes one from doing the same calculations for the year 1960. The advantage, though, of using 1960 is that we can compare the theoretical predictions of the neo-classical model to actual data. We use exactly the same parameters as GJ for the calibration of the autarky rates of return. The coefficient of relative risk aversion is set to one (log utility), the time discount rate is 0.96, and the long-run growth rate of total factor productivity is equal to 1.2% per

[5] Recall that GJ are interested only in the role of capital scarcity, and so they do not allow for any long-run differences between countries.

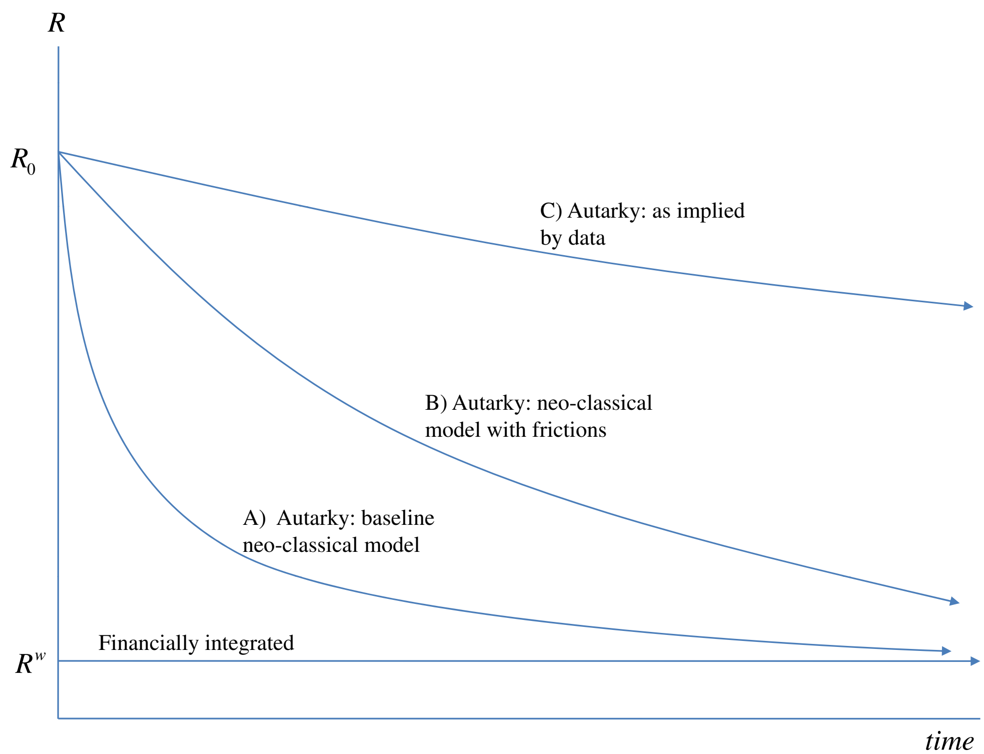

Figure 1: Rates of return over time under different assumptions

Notes: This figure plots stylized paths of the rate of return under different scenarios. From an initial value of R_0, a financially integrated country would have a path of the domestic rate exactly equal to R^w. If that country were in autarky, though, the baseline neo-classical model would predict a path as in curve A. Adding frictions to accumulation to the neo-classical model would slow down the convergence of the rate of return to the world rate, as in curve B. Finally, our data show that rates of return are actually very slow to converge towards the world rate, as in curve C.

year. The initial values of the rate of return for each country, R_{1960}, is derived from the following equation

$$R_{1960} = 1 - \delta + MPK_{1960} = 1 - \delta + \alpha \frac{Y_{1960}}{K_{1960}} \tag{12}$$

where the depreciation rate is set to 6% per year, as in GJ, and α is set to 0.3. The value of Y_{1960} is taken from the Penn World Tables 6.1, and the value of K_{1960} is calculated by a perpetual inventory method, as in Bernanke and Gurkaynak (2001), using investment data from the Penn World Tables as well. Subsequent values of R_{t+1} are found in the same manner as GJ, using the Ramsey model to solve for the optimal path of capital (equation (37) in Appendix A), and backing out the rate of return (equation (32)).

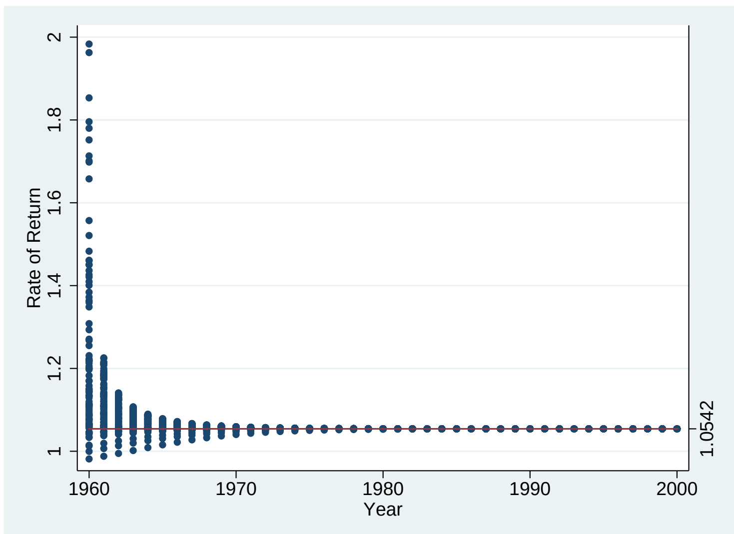

Figure 2: Neo-classical Predicted Autarky Rates of Return, 1960-2000

Notes: The figure displays the predicted rate of return on capital for all 102 countries in the sample, by year. The return is the marginal product of capital calculated from the neo-classical model of optimal savings assuming the country is in autarky, as described in the text. The *assumed world rate*, equal to 1.0542, is denoted by the horizontal line.

Figure 2 plots the values of R_{t+1} for 102 countries in our sample, by year, as predicted by the baseline autarky neo-classical model. In 1960 there is a wide spread of rates of return, running from around 1 to nearly 2 (an implied return of 100%). Very quickly, though, the predicted autarky rates of return converge towards the long-run world rate of 1.0542. By 1975, there is essentially no variance remaining in the predicted rate of return, as every country is assumed to be very close to this long-run steady state. Given the calculation in (10), we see that there is little scope for welfare gains, regardless of how large is the initial autarky rate of return. The predicted autarky rate of return, after discounting, will be very close to the assumed R^w, and hence μ will be small even for countries that begin with a very large value of R_{1960}.

Now, rather than relying on the neo-classical model to predict the rate of return on capital from 1960 forward, we look at the actual data on the rate of return. If the rate of return converges slower than what is implied by the neoclassical model, this means that GJ under-estimate the welfare gains of integration. We plot the values of R_{t+1} from 1961 to the year 2000, now calculated in exactly the same manner as was R_{1960} as given in equation (12), using data from the Penn World Tables for output and investment to derive Y_t and K_t in every year.

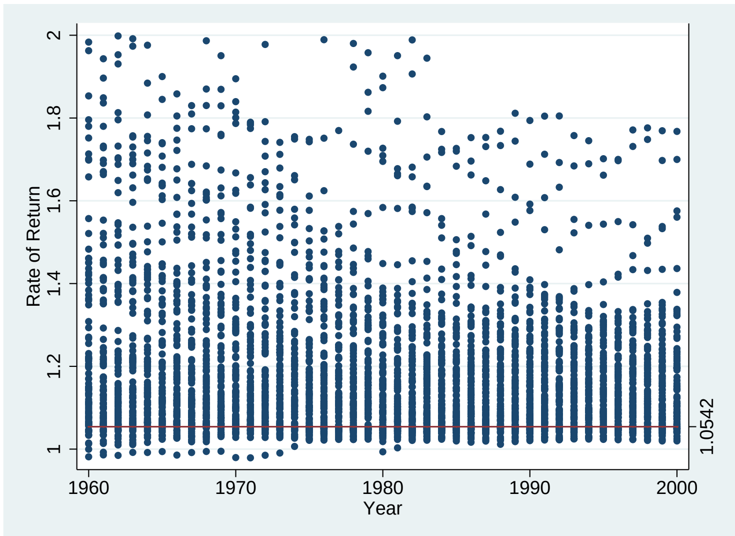

Figure 3: Observed Rates of Return, 1960-2000

Notes: The figure displays the observed rate of return on capital for all 102 countries in the sample, by year. The return is the marginal product of capital calculated from observed capital stock and output data, as described in the text. The *assumed world rate*, equal to 1.0542, is denoted by the horizontal line.

Figure 3 plots these calculated rates of return for each of the 102 countries in our sample, by year. As can be seen, the initial spread of returns in 1960 declines only slightly over the forty years of data we have. What this means is that the neo-classical model of autarky severely *under*-estimates the welfare gains of financial integration. To see the issue more clearly, consider figure 4, which plots the average value of the observed rates, the average value of the neo-classical autarky rates, both over the 102 countries, and the world rate. From this it is apparent that there is some tendency for observed rates of return to decline over time, but at a much slower rate than the neo-classical model predicts.

2.3 Convergence Speed and Welfare

What GJ established was that the assumed path of rates of return in autarky were an essential input into calculating the welfare gains of financial integration. What we have shown is that trusting in the neo-classical model to provide those autarky rates of return gives a very unrealistic view of how countries would actually act in autarky.

Rather than relying on the neo-classical model to describe autarky, we would like a more general method

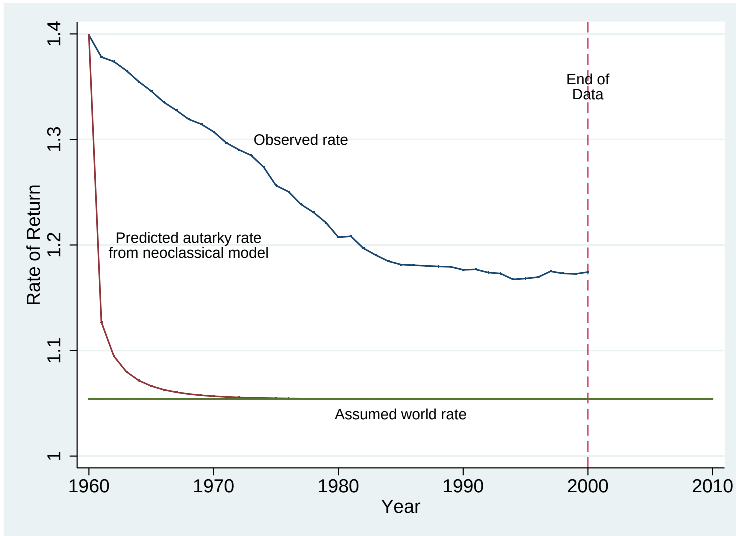

Figure 4: Comparison of Rates of Return, Averaged over Sample, 1960-2000

Notes: The figure displays the mean values of three different rates of return over the sample of 102 countries. The *observed rate* is the marginal product of capital calculated from observed capital stock and output data, as described in the text. The *predicted autarky rate of return* is the marginal product of capital predicted by the neo-classical model of optimal savings described in the text. The *assumed world rate* is equal to 1.0542.

that would allow us to incorporate what we learn from the observed data. To do so, let us define the dynamics of the rate of return under autarky as

$$R_{t+1} - R^w = (R_1 - R^w)\lambda^t \quad \forall t > 1 \tag{13}$$

where R_1 is the initial autarky rate of return (i.e. the rate of return that one could earn by investing at time zero). $\lambda \in (0, 1)$ is a parameter that measures the speed at which R_{t+1} converges to the level of R^w. We apply this formula from period one forward, so that at time zero the gap is exactly $R_1 - R^w$ regardless of the value of λ. This parameter can be interpreted as half-life of the gap between R_1 and R^w, or alternatively the value $(1 - \lambda)$ can be understood as the percent of the return gap that is closed each period. The larger the value of λ, the slower the convergence rate.[6]

The welfare benefit of financial integration, given R_1 and λ and the formula for μ in (10), is

$$\mu^\lambda = \beta \frac{1 - \beta}{1 - \beta\lambda}(R_1 - R^w)\overline{\kappa}. \tag{14}$$

From this it is clear that the convergence speed λ plays a central role in determining the welfare gains of

[6]Note that viewing convergence in the above way does not affect the underlying assumptions of the model, it simply is a way of parameterizing the convergence process. An alternative model that includes explicit frictions, such as human capital, as in Gourinchas and Jeanne (2006) and Mankiw et al. (1995), could still have its convergence captured empirically by equation 13. Models with frictions that slow down convergence would simply result in a larger value of λ.

financial integration. That is, the speed at which a country would reach R^w in autarky determines how beneficial integration can be.

Consider the case in which convergence is instantaneous, $\lambda = 0$, so that $R_{t+1} = R^w$ for every period after period zero. In this case $\mu^0 = \beta(1-\beta)(R_1 - R^w)\overline{\kappa}$. In contrast, when convergence never takes place and $\lambda = 1$, then $\mu^1 = \beta(R_1 - R^w)\overline{\kappa}$. Comparing the two we see that welfare with no convergence relative to welfare with instantaneous convergence is

$$\frac{\mu^1}{\mu^0} = \frac{1}{1-\beta} \tag{15}$$

regardless of the size of $(R_1 - R^w)$ or of $\overline{\kappa}$. For a value of $\beta = 0.96$, this means the ratio is equal to 25. When there is no convergence in autarky, welfare under integration is 25 times larger than when the economy converges to R^w instantly.

So the question becomes now, what value of λ is appropriate? How fast does the rate of return converge towards the world rate in autarky? In the following section we will develop an answer empirically. As a benchmark, first we want consider the size of λ implied by the neo-classical model, as implicitly assumed by GJ. In their work, they report that for an initial rate of return of $R_1 = 15\%$ and $R^w = 5\%$, a 1% inflow of capital ($\overline{\kappa} = 1$) would yield a welfare benefit of only $\mu = 0.014\%$. From (14), we can back out the value of λ they use. This turns out to be $\lambda^{GJ} = 0.76$. In other words, 23% of the gap between R_{t+1} and R^w closes each period.[7]

Let us compare the welfare gain of integration under a generic speed of convergence, λ, to the welfare gain calculated by GJ. This is, given their assumed value of $\rho = 0.96$,

$$\frac{\mu^\lambda}{\mu^{GJ}} = \frac{1-\beta\lambda^{GJ}}{1-\beta\lambda} = \frac{0.2704}{1-0.96\lambda}. \tag{16}$$

If $\lambda = 1$, or there is no convergence to R^w in autarky, then this ratio is equal to 6.76, or the welfare gains of integration are almost 7 times higher than estimated by GJ.

2.4 Estimation of Convergence Speed

To provide a clear estimate for the actual size of λ we will turn to the data. What we are doing, essentially, is using the data from 1960–2000 and extrapolating the time path of R_{t+1} from this into the future. Figure 5 shows our approach visually. Using the observed data we will estimate the parameter λ, the rate of convergence in rates of return. Then, using this λ we will be able to calculate an exact value for μ^λ, the welfare gain of integration relative to the GJ estimates.

Taking logs of equation (13), and explicitly assuming that this will hold for each country i, we have that

$$\ln\left(R_{i,t+1} - R^w\right) = \ln\left(R_{i,1} - R^w\right) + t \ln\lambda. \tag{17}$$

We have a panel of data on $R_{i,t+1}$, described in the previous section, over the period 1960-2000. The value

[7] Note that this is the convergence rate of the return to capital, not of output. Output converges to the steady state in their initial model at the rate of approximately 11% per year.

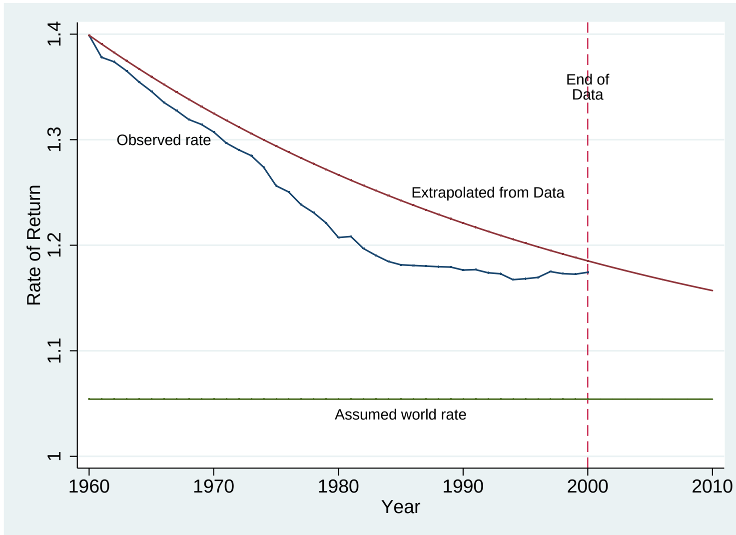

Figure 5: Rates of Return, Averaged over Sample, 1960-2000, and Extrapolated Values

Notes: The figure displays the mean values of three different rates of return over the sample of 102 countries. The *observed rate* is the marginal product of capital calculated from observed capital stock and output data, as described in the text. The *extrapolated* is estimated from the observed rates. The *assumed world rate* is equal to 1.0542.

$R_{i,1}$ is a country-specific time-invariant constant. We assume that the fundamental convergence rate λ is constant across countries. The idea, then, is to recover the value of λ by regressing $R_{i,t+1}$ on time.

This depends on the value R^w. But note that in (16) the actual size of $R_{i,1} - R^w$ is not relevant. The welfare gains relative to GJ depend only on the convergence speed, and this holds regardless of what we assume R^w actually is. We maintain the assumption that the value of $R^w = 1.0542$.

The estimation equation can be written as follows,

$$\ln(R_{i,t+1} - R^w) = \alpha + \upsilon_i + \rho t + \epsilon_{it} \tag{18}$$

where α is a common constant, υ_i represents a country-specific fixed effect (and captures the level of $R_{i,1}$), ρ is the estimated coefficient on time, and ϵ_{it} is a country-time specific error term. Comparing the estimation in (18) to (17), we see that $\rho = \ln \lambda$, so that we can back out the value of λ from the estimated value of ρ.

Using all 104 countries for which we have data (yielding 4243 total observations) the estimated value of ρ is -0.0242, with a standard error of only 0.0037, indicating significance at 1%.[8] This value of ρ implies a value of $\lambda = 0.9761$.[9] Similar regressions done for different sub-samples show that the estimated value of λ

[8] We estimate (18) using fixed-effects and correcting our standard errors for heteroscedasticity, assuming that ϵ_{it} is orthogonal to both time and υ_i.

[9] The Delta Method allows us to calculate a standard error for λ as well. This method uses a Taylor series expansion of $\lambda = exp(\rho)$ to show that the variance of λ is equal to $V(\rho)exp(\rho)^2$ where $V(\rho)$ is the estimated variance of ρ. This implies a standard error of λ of 0.0036, so that it is significant at less than 1% as well.

does not vary from 0.9761 by more than 0.004.[10]

2.5 Welfare Gains with Estimated Convergence

The cross-country data indicates that the true rate of convergence under autarky is quite slow. Our estimates of λ, which are likely under-estimated because countries in our sample are not perfectly autarkic, all are near 0.98 or higher. This means that only 2% of the gap between R_{t+1} and R^w is closing every period, regardless of country.

The purpose of these estimates was to evaluate how much the neo-classical model under-estimates the welfare gains of financial integration. For that we had established a ratio in equation (16) that compared the welfare gain with a convergence rate of λ to the results found by GJ. Using our lowest end estimate of $\lambda = 0.9761$, this ratio is equal to 4.30. In other words, the welfare gains of integration are at least 4.3 times larger than estimated by GJ, for every country. Their benchmark estimates suggest that the average welfare gain was equivalent to a permanent 1.74% gain in consumption. With our low-end convergence estimate, this would actually be equal to 7.47%.

2.6 Potential Problems with Estimated Convergence

We have shown that welfare gains of financial integration can be much larger if we calculate the cost of autarky from the actual data instead of following the predictions of a closed economy Ramsey model. Is this reasonable? There are two issues here where our strategy may be inflating the welfare gains given the estimated slow autarky convergence. First, our estimated autarky convergence is based on observed rates of returns and these rates may not be a good proxy for what happens in autarky. Second, we slow down the autarky convergence based on real rates but we assumed financial integration made convergence instantaneous. Observed rates of return in our sample are from both autarkic and integrated countries during the last four decades and it is clearly the case that convergence even under integration is not instantaneous. In this section, we tackle both of these issues and show that our strategy is reasonable even under the extreme cases.

What does our slow autarky convergence imply for output convergence?

Our results indicate that rates of return converge very slowly to world rates under autarky. Given the estimate of $\lambda = 0.9761$, our data implies that 2.39% of the gap between R_{t+1} and R^w closes every period.

One way to see if this rate is reasonable is to ask the following: What does this rate imply about the convergence rate of output per capita? Appendix C shows how one can approximate the value of output convergence from the convergence of rates of return. This shows that output convergence will be less than 2.39%, but approaches that value as time goes to infinity.

[10] The sub-samples are Central and South America (22 countries), Asia (15 countries), Middle-East and North Africa (8 countries), Sub-Saharan Africa (38 countries), and Europe, the Neo-Europes, and Japan (32 countries).

This relatively slow rate of output convergence is right in line with the existing growth literature, which generally finds convergence rates of about 2% per year, as noted by Barro and Sala-i-Martin (1992). This result holds across countries, U.S. states and the OECD (Barro and Sala-i-Martin, 1992), Japanese prefectures, European regions, and Canadian provinces (Sala-i-Martin, 1996a,b), Indian provinces (Cashin and Sahay, 1996), and Swedish counties (Persson, 1997).

While there are panel studies, such as Caselli, Esquivel and Lefort (1996), that report much faster convergence rates of around 11% per year, there appear to be biases built into the estimations. Durlauf, Johnson, and Temple (2005) discuss the issues with the panel approach, and in particular the GMM estimation of Caselli et al. Their conclusion is that these estimates of fast convergence are not reliable. Note that if one assumes the implied autarky convergence by the Ramsey model to calculate the welfare gains as done in GJ, this rate will correspond to a much faster output convergence of 11-13%, which is not supported by the empirical evidence on output convergence.

Are observed returns reliable?

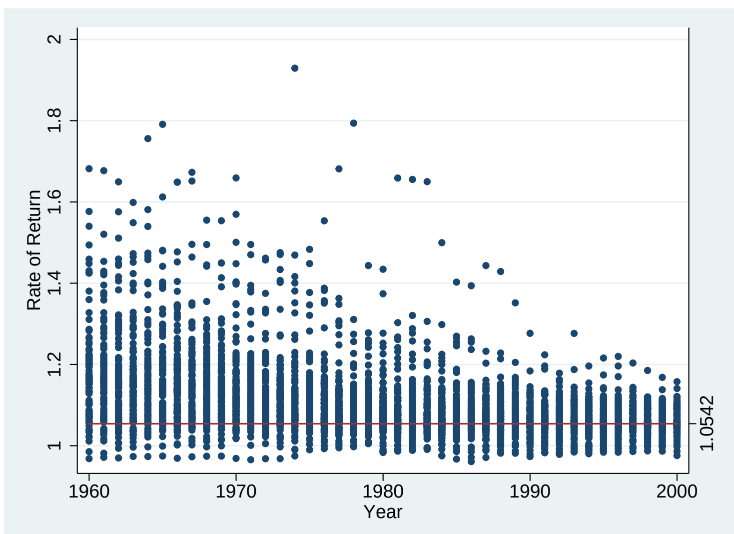

Figure 6: Observed Rates of Return, 1960-2000

Notes: The figure displays the observed rate of return on capital for all 102 countries in the sample, by year. The return is the marginal product of capital calculated from observed capital stock and output data, as described in the text, adjusted for relative prices as in Caselli and Feyrer (2007). The *assumed world rate*, equal to 1.0542, is denoted by the horizontal line.

Autarky convergence rates based on actual observed returns might be reasonable based on what those returns imply for output convergence as shown above. However maybe those returns themselves are not reasonable. In fact, we see capital flowing to places we do not expect based on observed returns. Part of the literature has argued that this is due to various frictions or quality of institutions.[11] Caselli and Feyrer (2007), on the other hand, have argued that observed returns are mis-measured. They show that MPKs are actually similar across countries once they are adjusted to take into account of various distortions such as the differences in relative price of capital versus consumption. Applying their adjustments to the MPKs shown in figure 6 we still obtain similar results regarding the relatively slow convergence under autarky (see appendix C for details).

Do the observed rates proxy autarky convergence?

As noted, our estimates of λ do not capture a true autarky path of rates of return. The data is composed of countries in varying states of financial integration during 1960–2000. However, these capital flows should have accelerated the convergence of rates of return to the world rate. In other words, the real *autarky* path of the rate of return in our sample would converge *slower* than what we would infer from the data. Hence we over-estimate the speed of autarky convergence, and this worked against us finding significant welfare gains. If we restrict ourselves to the time period 1960–1980, prior to the broad opening of global capital markets, our ultimate results on autarky convergence are very similar.

Is the assumption of instantaneous convergence under integration reasonable?

One thing working *for* the finding of large welfare gains is that we are still assuming financial integration is "perfect". That is, integration implies that capital flows into a country immediately and in sufficient amounts so that the rate of return drops to the world rate. This maximizes the gains of integration relative to autarky, but may not be realistic when thinking about actual integration for a developing country. Countries do not converge to the world interest rate immediately upon integration and studies such as Mankiw, Barro, and Sala-i-Martin (1995) introduce frictions into the benchmark model to slow down the speed at which countries approach the world rate upon opening up. If convergence under integration is slow, then the welfare gains of integration will be smaller, regardless of what happens in autarky.

To see this, consider figure 7, which plots stylized paths of the rate of return under different scenarios. The autarky path shows a slow convergence to the world rate over time, as found in the data. In the prior work, we had been assuming that upon integration, the rate of return dropped immediately to R^w, denoted here as "perfect" integration. This maximizes the area between the autarky and the integration paths, and this area can be seen as a rough approximation of the welfare gain of integration.

In contrast, the path denoted "slow" integration plots a rate of return that is lower than autarky, implying an inflow of foreign capital. However, the inflows are slow, and so the rate of return does not converge immediately. Now, notice that the area between the "slow" integration curve and the autarky curve is smaller, implying smaller welfare gains.

To address quantitatively the effect this is having on our results, let us consider a modification of our calculations that allows for "slow" financial integration, as in Mankiw, Barro, and Sala-i-Martin (1995).

[11] See Alfaro et al. (2008).

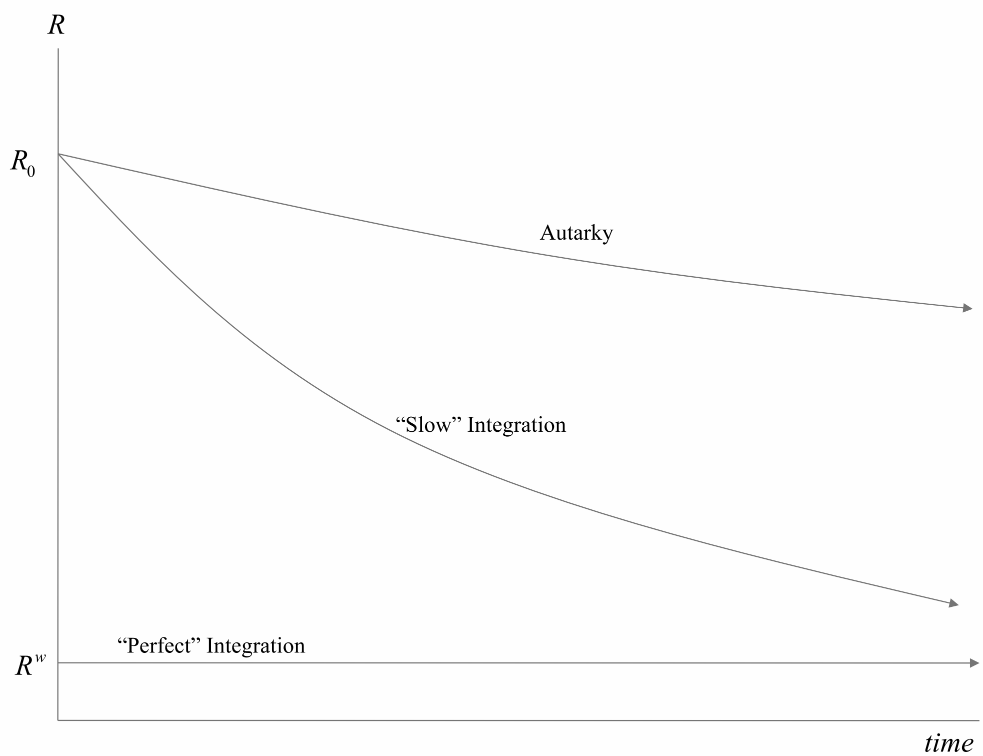

Figure 7: Rates of return under different regimes of integration

Notes: This figure plots stylized paths of the rate of return under different scenarios. From an initial value of R_0, a "perfect" financially integrated country would have a path of the domestic rate exactly equal to R^w. "Slow" integration implies that the rate of return declines, but not immediately, upon integration.

Convergence to the long-run steady state will be faster than in autarky, but not instantaneous. To specify this, let

$$R^w_{t+1} - R^w = (R_1 - R^w)\phi^t \tag{19}$$

where R^w_{t+1} is the open economy rate of return in period $t+1$, while R^w is the long-run steady state world rate of return, and R_1 is again the observed initial domestic rate of return. The parameter ϕ dictates the speed at which the open economy rate converges to R^w (and hence the speed of capital flows to the country).

Returning to equation (10), recall that our measure of the welfare gain of integration, μ, depends on the discounted difference between the autarky rate of return and R^w. We can adapt this to incorporate a time-varying open economy rate as in

$$\mu^{slow} \equiv \beta\left(\hat{R} - \hat{R}^w\right)\overline{\kappa} \tag{20}$$

where $\hat{R}^w = (1-\beta)\sum_0^\infty \beta^t R^w_{t+1}$ is the discounted value of the world rate of return, similar to the specification for the autarky rate in (11).

μ^{slow} thus gives the welfare gain from integration where integration is "slow" and the open economy rate dictating capital flows to a country converges at the rate ϕ to the long-run world rate R^w. If we compare this to the welfare gain from "perfect" integration, as we analyzed before, we have

$$\frac{\mu^{slow}}{\mu^\lambda} = 1 - \frac{1-\beta\lambda}{1-\beta\phi} \tag{21}$$

where λ is the speed of convergence under autarky.

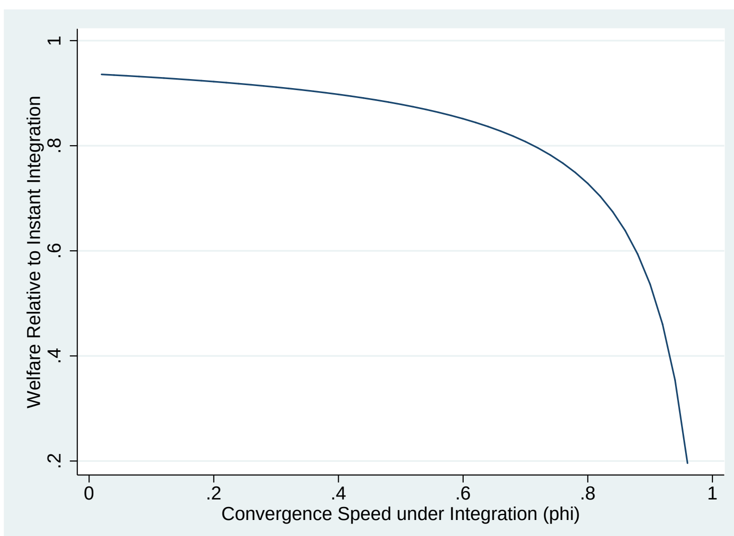

Figure 8: Relative Welfare of Slow Inegration

Notes: The figure displays relative welfare of slow financial integration with the welfare of perfect, or instant, financial integration.

This comparison is more general then comparing slow convergence in autarky to slow convergence under financial integration since the parameter λ captures both slow and fast autarky convergence. The speed of convergence when integrated, ϕ, is thus crucial for determining how big welfare is with slow integration relative to perfect integration. As ϕ goes to zero, the ratio goes to $\beta\lambda$. If $\phi = \lambda$, then integration is no better than autarky, and the ratio is equal to zero.

Between the two extremes, we can graph the ratio of welfare in slow integration to perfect integration. Figure 8 shows how μ^{slow}/μ^{λ} changes with ϕ, given a value of $\beta = 0.96$ and a value of $\lambda = 0.976$ (the estimated value). As can be seen, there is not a significant drop in welfare at even relatively high values of ϕ. Even with ϕ equal to 0.7, our estimates suggest that welfare gains are equal to 80% of those mentioned previously. Relative to the GJ estimates, this means that the welfare gain of integration is 5.98% as opposed to their 1.74%, but less than the gain of 7.47% with perfect financial integration.

What value of ϕ is appropriate, though? That is, how fast do rates of return converge upon integration. In certain situations, the convergence can go very quickly. Consider Singapore, where following the reforms of Lee Kuan Yew in 1965, the rate of return fell from 1.581 to only 1.055 by 1980. In other words, the rate of return converged to the world rate in only 15 years. This implies a value of $\phi = 0.25$, which suggests that the welfare gains are about 90% of those of "perfect" integration.

For other countries, the experience of financial integration has been slower, either by design or circumstances. China, for instance, has become more integrated into world financial markets since the early 1980's. From 1985 to 2000, the rate of return in China fell from approximately 1.085 to just over the world rate of 1.054. Given the initially small gap between domestic and world rates, this implies a relatively slow rate of convergence under a tightly controlled process of financial integration. The implied value of ϕ in China is 0.79, which indicates their integration still provides about 80% of the benefits of a "perfect" integration.

So while no country is likely to experience a "perfect" integration into world financial markets, this does not appear to change the fact that financial integration can deliver large welfare gains. Rather than the 7.47% average welfare gain we estimated earlier, a slower process of integration along the lines of the Chinese experience would still deliver a welfare gain equivalent to a 6% increase in consumption.

3 Productivity Effects

Our analysis to this point has presumed that foreign capital markets offer only one benefit: the ability to shift consumption across time. However, as argued in the introduction, there is extensive evidence, both at the country-level (See Kose, Prasad, Rogoff, and Wei (2009)) and at the firm-level (Javorcik (2004)), that foreign capital has effects on productivity itself, even holding constant the actual capital stock. In this section, we tackle this issue by allowing productivity effects of foreign capital.

Recall from equation (6) that the gain in welfare from inflows of foreign capital derives from the net gain in income multiplied by the marginal utility of consumption. How does this change if foreign capital has a direct effect on productivity itself?

Let output be described by $y = Ak^{\alpha}$, and describe total factor productivity as

$$A = exp(\theta \frac{k^f}{k}) \tag{22}$$

where k^f is the amount of foreign capital per person and θ is a parameter measuring the strength of the effect that foreign capital has on productivity. What this formulation captures is that the share of the capital stock held by foreigners is important, not necessarily the absolute amount. Therefore the sale of some domestic capital to a foreign company can increase productivity even if the actual capital stock does not increase. This is in the spirit of knowledge spill-overs, as it does not require the actual stock of capital to increase for productivity to increase.

Appendix B shows that given this formulation of the effect of foreign capital on TFP, we can write the welfare benefit of an incremental increase in foreign capital as

$$\mu^{FDI} \approx \beta \left(\hat{R} - R^w\right) \left(1 + \frac{\theta}{\alpha}\right) \hat{\kappa}. \tag{23}$$

Therefore, relative to (10), regardless of the speed of convergence, the welfare effects of integration if there are productivity effects will be larger the larger the value of θ, the effect of foreign capital on productivity. Our task now is to evaluate what an appropriate value of θ may be.

3.1 Foreign Capital and Productivity

As argued in the introduction, Obstfeld (2009) and Kose, Prasad, Rogoff, and Wei (2009) conclude that the macro-economic literature does not seem to find a robust significant effect of financial integration, measured either as FDI flows or total flows, on economic growth due to the identification problem. The endogenity issue of foreign capital coming into productive countries becomes worse when also there are specific channels through which foreign capital affects productivity. There are several channels by which foreign capital may enhance total factor productivity within domestic economies: the easing of financing constraints (Harrison, Love, and McMillan, 2004), increased competition and a reduced cost of capital (Henry, 2003), improved productivity of domestic firms through spillovers/lingakes (Aitken and Harrison, 1999; Javorcik, 2004; Blalock and Gertler, 2005), and facilitating risk sharing and hence investment in riskier and high yielding projects (Obstfeld, 1994; Kalemli-Ozcan, Sorensen, and Yosha, 2003).[12]

To get an estimate value of θ we pursue a strategy similar to that of Klenow and Rodriguez-Clare (1997). This and a number of subsequent papers (Hall and Jones, 1999; Caselli, 2005; Weil, 2007) use micro-level estimates of the effects of different factors (years of schooling, health, etc.) on income in order to infer the effect of such factors on aggregate development. Similarly the micro literature argues that if there is any effect of financial integration on growth and welfare this should come from FDI since FDI brings new technology, management practices, and technological know-how. Here we will use micro-level estimates of

[12] Note that this is a selective list of references and the reader should see the extensive survey of Kose, Prasad, Rogoff, and Wei (2006) for a full list.

the productivity effect of FDI (θ) in order to infer the effect of aggregate FDI flows on output per capita. The value of this approach is that one can, by judicious choice of micro-level studies, avoid the endogeneity issues that plague macro-level work. While not an ideal solution, the previous studies have shown that using the micro estimates in this manner can be a useful in gauging the aggregate magnitude of a specific factor, such as years of education. We adopt this strategy to similarly gauge the magnitude of the effect of FDI on productivity.

Starting with Caves (1974), researchers originally focused on country case studies and industry level cross sectional studies. These studies find a positive correlation between the productivity of a multinational enterprise (MNE) and average value added per worker of the domestic firms within the same sector. Of course a positive cross-sectional correlation between firms productivity and wages and FDI suffers from the problem of endogeneity and is not necessarily informative. It does not reveal whether FDI raises productivity or whether multinationals are attracted to regions and industries in which domestic firms are more productive and workers are more skilled.

A more promising approach is to investigate the change in firm productivity and the change in FDI, where the unobserved time-invariant industry and region factors that affect firm productivity are removed. The standard regression of this approach is as follows:

$$\Delta y_{it} = \Delta X_{it}\phi_0 + \Delta FDI_{it}\phi_1 + \epsilon_{it} \tag{24}$$

where y_{it} is some measure of firm level productivity and X_{it} represents firm specific controls. A positive estimate of ϕ_1 is interpreted as positive spill-overs. There are many studies within this framework. However, starting with Aitken and Harrison (1999) most of these studies find a negative effect or no effect of foreign presence.[13] Positive spill-over effects are found only for developed countries. Moran (2005) argues that the original industry and case studies underline the importance of competitive environment and this might explain why studies find negative results in studies about countries who pursued inward oriented policies, such as Venezuela (Aitken and Harrison, 1999).[14] In addition, these panel studies suffer from another identification problem. The underlying assumption that changes in FDI are exogenous to unobserved shocks to firm's productivity is hard to justify. There are two ways to proceed: 1) To find an instrument for FDI, a hard task given the difficulty in thinking of a factor that is correlated with attractiveness of an industry or region which is at the same time uncorrelated with domestic firm's productivity; or 2) To find a natural experiment, i.e., a control group that takes care of the unobserved shock.

Given these issues, we focus on several recent studies from the literature that have dealt carefully with the endogeneity issues and have produced well-identified estimates on the causal role of FDI on productivity at the firm level.

[13] See surveys by Gorg and Strobl (2001) and Lipsey (2004).

[14] This is also true for the panel studies of Colombia, India, and Morocco. Note that the famous Rodrik dictum "One dollar of FDI is worth no more (or no less) than a dollar of any other kind of investment" is based on Venezuelan and Moroccan studies.

3.1.1 Direct Productivity Effects

To be useful in our exercise, estimates of the effect of foreign ownership on productivity must overcome several issues. The first is that acquired plants are not randomly selected from the population, biasing estimates if this simultaneity is not accounted for. Essentially, do firms become more productive because they receive FDI, or does FDI "cherry pick" the most productive firms in a developing economy? The second issue is that the estimates must be for firm total factor productivity, not partial measures such as output per worker. Finally, the actual measure of total factor productivity should be estimated correctly, accounting for the simultaneous nature of productivity and input decisions. Of the variety of studies of foreign ownership and firm level productivity, we identify three that fit our criteria: Evenett and Voicu (2003), Javorcik (2004), and Arnold and Javorcik (2005).

Arnold and Javorcik (2005) study Indonesian firms during the period 1984–1994 and use a propensity score matching method to identify the effect of foreign acquisition on firms total factor productivity. The propensity matching yields a sample of acquired firms matched with statistically identical non-acquired firms.[15] The authors then use difference-in-differences to estimate the effect of acquisition on the "treated" group, the acquired firms. Their estimates show a 34% increase in productivity from foreign acquisition in their preferred specification using 185 matched pairs of firms (one acquired by foreigners and one not).

The specifications from Arnold and Javorcik assume that log TFP is a linear function of foreign ownership, just as in our assumed functional form (22), so that productivity takes the functional form of

$$\ln TFP = \theta D^f \tag{25}$$

where D^f is a dummy variable for foreign ownership, and θ is the estimated effect of foreign ownership on productivity. The preferred estimates of Arnold and Javorcik show θ equal to 0.293.

In their paper they measure $D^f = 1$ if a firm has foreign ownership greater than or equal to 20%, and a value of zero otherwise. We presume that the effect is continuous, essentially translating their specification into the form $\ln TFP = \theta k^f/k$, and the maximum productivity effect only holds when foreign ownership reaches 100%. Therefore we underestimate the effect of foreign capital on productivity.

The study of Evenett and Voicu (2003) looks at a sample of Czech firms in the period 1995–1998. They find that when they account for sample attrition and selection problems, there are substantial productivity benefits to firms that received FDI. Their empirical specifications are similar to Arnold and Javorcik (2005) and their estimated value of θ is 0.358, from a sample of 205 firms.

3.1.2 Spill-over Effects

In Javorcik (2004), significant effects of FDI are found when firms act as suppliers to foreign-owned firms, even if they are not foreign-owned themselves. The measure of downstream FDI is a proxy for the share of

[15] This technique is used to create a control group of firms that are statistically identical to the acquired firms. The technique depends on the sample of acquired firms looking very similar to the non-acquired firms in the first place. If the acquired firms are distinctly different from non-acquired firms in all the observable variables, then the technique will not be valid. Arnold and Javorcik document that their acquired and non-acquired firms are nearly identical on all the variables they have data for.

output that is sold to foreign-owned firms. As this data is not available by firm, the study assumes that each firm in sector j supplies to sector m according to the national input-output tables. The foreign share in sector m is based on a measure of horizontal FDI in that sector. The combined measure is written as

$$DownFDI_j = \sum_m \alpha_{jm} \sum_{i \in j} \frac{(k_i^F/k_i)Y_i}{\sum_{i \in j} Y_i}. \tag{26}$$

This shows that downstream FDI depends on the parameters of the input-output tables, α_{jm}, as well as the foreign share of firm capital (k_i^F/k_i). As this share increases in any sector m, the $DownFDI_j$ index increases.

The productivity effects of this downstream FDI as specified by Javorcik imply a productivity function nearly identical to that in (25)

$$\ln TFP = \theta DownFDI_j \tag{27}$$

where θ now measures the effect of FDI spill-overs on productivity. From Javorcik we obtain several estimates of θ that lie between 0.035 and 0.041.[16] As the $DownFDI_j$ measure is continuous (i.e. does not use a cutoff value as the direct productivity studies did), we translate the value of θ directly to an elasticity θ.[17]

3.2 Welfare Gains with Endogenous Productivity

The studies on the direct effects of FDI yield estimates of θ equal to 0.293 and 0.358. The indirect spill-over effects suggest θ is equal to 0.035 to 0.041. One could argue that these effects should be cumulative, with both direct and indirect influences of foreign capital on productivity. Given the small size of the indirect effects, it seems fair to use an overall value of θ equal to 0.328, the sum of the low end estimates for both direct and indirect effects.

Given this value, we can evaluate the value of μ^{FDI}, the welfare gain of financial integration taking productivity effects into account. Given (23), this suggests that

$$\mu^{FDI} = \rho\left(\hat{R} - R^w\right)\left(1 + \frac{\theta}{\alpha}\right)\overline{\kappa} = 2.093\mu \tag{28}$$

once we use our values of $\theta = 0.328$ and $\alpha = 0.3$. What this says is that once we account for the productivity effects of foreign capital, the welfare gains are roughly twice as large as any welfare gains calculated ignoring these effects.

This holds regardless of what the actual convergence speed of autarky rates of return is. That is, even if we assume that GJ's calculations are correct, then with productivity effects accounted for the welfare gain of

[16] We specifically use the Olley-Pakes estimates from panel A of Javorcik's table 7. The sample is 11,630 observations from between 1,918 and 2,711 Lithuanian firms a year between 1996–2000.

[17] In addition to Javorcik (2004), recent research by Blalock and Gertler (2005) has shown significant effects of foreign ownership on productivity. Their evidence on the direct productivity effects is convincing in that they use the "natural experiment" of Indonesia's currency crisis to identify the effect of foreign ownership on output, capital accumulation, and employment across Indonesian firms. However, they focus only on exporting firms and so we do not utilize their estimates for our purpose.

integration is, on average, equal to $1.74\% \times 2.093 = 3.64\%$. If we allow for more realistic convergence speeds, then the welfare gain of integration allowing for productivity effects is equal to, on average, $7.47\% \times 2.093 = 15.63\%$. These are serious welfare benefits relative to the original estimates of GJ. They suggest that financial integration can be quite beneficial once we allow for realistic convergence rates and productivity effects.

Of course not every country will reap the full benefits of FDI on productivity, and this will likely be concentrated in the countries farthest behind the technological frontier. However, these countries are also the poorest countries, and thus have the most to gain by allowing in foreign capital. Additionally, we have only focused on specific firm-level benefits of foreign capital, and so we may be underestimating the influence of integration on productivity.

4 Conclusion

How beneficial financial integration is for a country depends on the economic conditions it would face *without* integration. We have explored the two main assumptions used by the previous literature to describe this autarky situation: a) capital accumulation is usefully described by a neo-classical Ramsey model, and b) productivity is the same in autarky as when financially open.

What we find is that the Ramsey model is a poor description of autarky. It presumes that in autarky a country will rapidly approach its long-run steady state. This implies that one major benefit of financial integration – jumping immediately to the steady state – is relatively unimportant. Data from 1960–2000 suggests that in autarky countries will only very slowly converge towards their steady state, and therefore financial integration can be a great benefit. Our estimates suggests that properly accounting for the convergence rate increases the welfare gains by a factor of 4.3 over previous estimates.

We also account for the fact that productivity growth may be higher with integration relative to autarky due to the productivity-enhancing effects of FDI. Using firm-level estimates to gauge the size of this effect, we find that allowing for this endogenous productivity raises welfare gains of integration by a factor of 2.

These two effects are multiplicative, and so our estimates suggest that the welfare gains of integration are 8.6 times larger than previously estimated. The literature has normally cited gains equivalent to a 1.74% permanent increase in consumption, and our work suggests that this should actually be closer to 15%. Thus financial integration would appear to have serious consequences for welfare.

Appendix A: Neo-classical Model of Savings

First, assume utility takes the form

$$V = \sum_{t=0}^{\infty} \beta^t (1+n)^t u(c_t) \tag{29}$$

where $\beta \in (0,1)$ is the time discount factor, n is the growth rate of the population and $u(c_t)$ is the utility of consumption in period t. For our purposes, we will assume that $u(c_t) = c_t^{1-\sigma}/(1-\sigma)$, a constant relative risk aversion utility function with $\sigma > 0$.

Production of output is described by the following Cobb-Douglas function

$$Y_t = K_t^{\alpha} \left(A_t L_t\right)^{1-\alpha} \tag{30}$$

where K_t denotes the stock of domestic capital, L_t is the labor supply, and A_t is a labor-augmenting measure of productivity. Labor supply is assumed to grow exogenously at the rate n, so that $L_{t+1} = (1+n)L_t$. Productivity grows at the rate g implying that $A_{t+1} = (1+g)A_t$. Both n and g are assumed to be specific to a country.

If we denote productivity and population normalized variables with a hat, $\hat{x}_t = x_t/(A_t N_t)$, then we can write the dynamic budget constraint for each economy as

$$\hat{k}_{t+1} = (1-\delta-n-g)\hat{k}_t + \hat{y}_t - \hat{c}_t \tag{31}$$

where δ is the depreciation rate. Additionally, denote the return on capital as

$$R_{t+1} = \alpha \hat{k}_{t+1}^{\alpha-1} + 1 - \delta. \tag{32}$$

Utility maximization delivers the Euler equation relating consumption over adjacent periods as

$$\hat{c}_{t+1} = \hat{c}_t \frac{(\beta R_{t+1})^{1/\sigma}}{1+g}. \tag{33}$$

At a steady state $\hat{c}_{t+1} = \hat{c}_t$ and thus the steady state return to capital is $R^* = (1+g)^{\sigma}/\beta$. Hence the steady state value of $\hat{k}^*$ can be written as

$$\hat{k}^* = \left(\frac{\alpha}{R^* + \delta - 1}\right)^{1/1-\alpha}. \tag{34}$$

Steady state consumption, $\hat{c}^*$, can then be found from the dynamic budget constraint in (31).

Financial Integration

Financial integration implies that capital will flow in or out of the economy until the rate of return is exactly equal to R^w. The capital stock per efficiency unit will be

$$\hat{k}^w = \left(\frac{\alpha}{R^w + \delta - 1}\right)^{1/1-\alpha} \tag{35}$$

and this then determines output per efficiency unit in integration, $\hat{y}^w$. From the dynamic budget constraint in (31), we can back out the value of $\hat{c}^w$ after noting that $\hat{k}_{t+1} = \hat{k}_t = \hat{k}^w$ upon integration.

Initial consumption per capita can be found in a straightforward manner, $c_0 = \hat{c}^w A_0$, where A_0 is the observed total factor productivity in year zero. For subsequent periods, the Euler equation can be used to solve for consumption per capita noting that the rate of return is fixed at R^w

$$c_t = c_0(\beta R^w)^{t/\sigma}. \tag{36}$$

Knowing the path of c_t and the initial value of c_0, we can simply calculated U^{int} from the utility function in (29).

Autarky

In autarky, the problem we have is to solve for the optimal path of consumption given the initial capital stock of k_0 and initial productivity A_0. The Euler equation in (33) and the dynamic budget constraint in (31) must be jointly satisfied along the optimal path.

As there is no simple analytical solution to this problem, we have to find the optimal paths by other means. One option is to solve the problem numerically, which we have done and found to be nearly identical to the second option, linearization.

Linearizing this system is tedious but straightforward. For a full exposition, see Barro and Sala-i-Martin (2004). First-order Taylor expansions of the Euler equation and the inter-temporal budget constraint are solved together to arrive at a solution for the optimal path of the capital stock per efficiency of

$$\hat{k}_{t+1} = (1-p)\hat{k}^* + p\hat{k}_t \tag{37}$$

where

$$p = \frac{\phi}{2} - \left(\frac{\phi^2}{4} - \frac{1}{\beta}\right)^{1/2} \tag{38}$$

and

$$\phi = 1 + \frac{1}{\beta} - \frac{\beta(1+g)^{1-\sigma}\alpha(\alpha-1)\hat{k}^{*(\alpha-1)}\hat{c}^*}{\hat{k}^*\sigma}. \tag{39}$$

Equation (37) says that next periods capital stock is essentially a weighted average of the steady state capital stock and the current capital stock. The weight, p, is ultimately a function of the basic parameters of the model, the steady state capital stock, and the steady state value of consumption per efficiency unit, $\hat{c}^*$. Steady state consumption is found by solving the inter-temporal budget constraint at the steady state level of capital per efficiency unit,

$$\hat{c}^* = \left(\hat{k}^*\right)^{\alpha} - (\delta + n + g)\hat{k}^*. \tag{40}$$

Similarly, optimal consumption in any given period $t \in (0, \infty)$ is found from the budget constraint along with the optimal values of $\hat{k}_t$ and $\hat{k}_{t+1}$ obtained from the linearization. Utility in autarky is then calculated given this consumption path from (29).

A crucial input to this calculation is the long-run growth rate of total factor productivity, g. To focus solely on capital scarcity, we assume, as do GJ, that this value is common to every country. More specifically, we presume that $g = 0.012$, a value matching the long-run growth rate of productivity in the United States.

What this means is that the steady state capital stock per efficiency unit in autarky, $\hat{k}^*$, is exactly equal to the value $\hat{k}^w$. In the long run, each country will reach the same steady state value. This is done so that we can focus exclusively on capital scarcity, as opposed to long-run differences in productivity. Of course, by assuming that $\hat{k}^* = \hat{k}^w$, we are assuming that $R^* = R^w$ in autarky as well. In other words, we impose that the rate of return on capital in autarky will eventually reach the world rate.

Appendix B: Adjusting Rates of Return for Relative Prices

As argued by Caselli and Feyrer (2007), the marginal product of capital depends not only the physical marginal product, but also on the purchase price of the investment goods. More details are available from their paper, but they propose that an accurate marginal product of capital is obtained as $(P_y/P_i)*\alpha*(Y/K)$, where P_y is the price of output, P_i is the price of capital, α is capital's share in output, and Y/K is the output to capital ratio.

Using data from the Penn World Tables, version 6.1, on the price of output and price of investment, we can recalculate the observed rates of return by adjusting the $\alpha(Y/K)$ term in our equation (12). If we do that and re-plot the observed rates from 1960 to 2000, we have figure 6. As can be seen, there is still evidence that convergence in this period is quite slow relative to the neo-classical predictions.

Appendix C: Convergence of Output per Capita

To see how the convergence rate of $R_{i,t+1}$ can inform us on the convergence rate of output per capita, begin with the convergence formula for $R_{i,t+1}$:

$$R_{i,t+1} = R_{i,t}\lambda + R^w(1-\lambda). \tag{41}$$

Knowing that $R_{i,t+1} = 1 - \delta + \alpha\hat{k}^{\alpha-1}$, we can write the previous equation as

$$\hat{k}_{i,t+1}^{\alpha-1} = \hat{k}_{i,t}^{\alpha-1}\lambda + \hat{k}_w^{\alpha-1}(1-\lambda) \tag{42}$$

where $\hat{k}_{i,t}$ is the capital per efficiency unit in period t, and $\hat{k}_w$ is the steady state capital per efficiency unit.

Multiplying each side by $\hat{k}_{i,t+1}$, we have

$$\hat{k}_{i,t+1}^{\alpha} = \hat{k}_{i,t}^{\alpha}\frac{\hat{k}_{i,t+1}}{\hat{k}_{i,t}}\lambda + \hat{k}_w^{\alpha}\frac{\hat{k}_{i,t+1}}{\hat{k}_w}(1-\lambda). \tag{43}$$

Given that output is $\hat{y} = \hat{k}^\alpha$, this provides a way of expressing convergence in output per capita. If we focus on the term $\hat{k}_{i,t+1}/\hat{k}_w(1-\lambda)$, this can be seen as the convergence speed of output. Because of the non-linear relationship between capital and output, this is not a constant. However, as can be seen, given that $\hat{k}_{i,t+1} < \hat{k}_w$, the convergence rate must be less than $(1-\lambda)$, but approaching $(1-\lambda)$ as time goes to infinity. Knowing $(1-\lambda)$ from our empirical estimation, we can infer that output convergence is no larger than this value.

Appendix D: Evaluating Welfare with Productivity Effects

Evaluating the welfare benefits involves specifying the marginal increase in net income following the inflow of another unit of foreign capital. Combining our definition of output per capita of $y = Ak^\alpha$ with the definition of $A = exp(\theta k^f/k)$, we have that a marginal increase in foreign capital will have two effects. First, it allows one to earn the marginal product of capital, and second, this will increase the marginal product of capital due to the productivity effect.

The first effect yields an increase in income of $(R_{i,t+1} - R^w)$. The second effect depends upon how much productivity goes up due to an increase in foreign capital. Holding the total capital stock constant, the increase in income from an increase in k^f working through productivity is

$$dy = \frac{\theta}{k} e^{\theta k^f / k} k^{\alpha} dk^f \tag{44}$$

which can be written as

$$dy = \frac{\theta}{\alpha} \alpha A k^{\alpha - 1} dk^f \tag{45}$$

which is simply the fraction θ/α times the marginal product of capital.

So in addition to the increase in income arising from the difference between the domestic rate of return and the world rate, the country earns an additional amount equal to θ/α times the return on capital. Thus the utility gain is

$$dU_{t+1} = u'(c_t)(R_{t+1} - R^w)\left(1 + \frac{\theta}{\alpha}\right) d\kappa_{t+1} \tag{46}$$

and the analysis proceeds as in GJ to yield a value for μ_i^{FDI} of

$$\mu^{FDI} \approx \rho\left(\hat{R} - R^w\right)\left(1 + \frac{\theta}{\alpha}\right)\overline{\kappa}. \tag{47}$$

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