NBER WORKING PAPER SERIES

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Working Paper 23921
http://www.nber.org/papers/w23921

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2017

We thank Pierre-Olivier Gourinchas, Mike Hutchison, Alwyn Young and seminar participants at the NIPFP Capital Flows Conference, Ministry of Finance, India and UNC-Chapel Hill. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research. Peter Blair Henry serves on the NBER Board.

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NBER Working Paper No. 23921
October 2017
JEL No. F21,F30,F43,F6,G15

ABSTRACT

This paper quantifies the welfare impact of a permanent increase in the level of per capita income brought about by a temporary increase in the growth rate of GDP per capita following capital account liberalization. In the immediate aftermath of liberalization, and under a range of assumptions, differences between the autarkic and integrated equilibrium consumption paths are large. Yet the welfare impact of these differences is small when using infinite horizon consumption streams to compute welfare gains. The results suggest that a finite horizon framework may be more appropriate and policy-relevant for evaluating the welfare consequences of economic policy changes that induce temporary growth effects but have a permanent impact on the level of per capita incomes.

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1 Introduction

The neo-classical model predicts that capital account liberalization will increase allocative efficiency across countries by allowing capital to flow from nations where it is abundant to those where it is scarce. The incipient flow of capital into liberalizing economies lowers their cost of capital and increases investment and economic growth, leading to a permanent increase in their standard of living [Fischer (1997, 2003); Obstfeld (1998); Rogoff (1999); Summers (2000)].

Research on the macroeconomic impact of capital account liberalization finds few, if any, robust effects of liberalization on real variables such as investment and GDP per capita [See surveys by Edison et al. (2002) and Kose et al. (2006) and the studies therein]. But it is a mistake to view the prevailing null effect findings as conclusive because most of the research papers in this area employ cross-sectional regressions designed to test whether liberalization produces permanent differences in the long-run growth rates of the economic variables of interest. In contrast to these tests for permanent effects of liberalization, theory predicts that liberalizing the capital account will have a temporary impact on growth rather than a permanent one [Henry (2007)]. Therefore, cross-sectional regressions that do not find permanent growth effects of liberalization do not undermine the predictions of the neo-classical model.

This paper quantifies the welfare impact of a permanently higher level of income per capita brought about by temporarily higher growth in the aftermath of capital account liberalization. If agents are infinitely-lived, the increase in consumption (welfare) brought about by liberalization may not be quantitatively important over the infinite lifetime consumption path [Gourinchas and Jeanne (2006)]. However, if the lion's share of the welfare benefits from liberalization accrues over relatively short horizons, and in the early years after policy implementation, then calculating the welfare benefits over a finite horizon may be more appropriate, and policy-relevant.

We use the neo-classical growth model to measure the welfare effects of closing the capital gap in moving from financial autarky to financial integration. Agents live in an infinite-horizon Ramsey world where under autarky, the economy has an endogenous consumption path that depends on the rate of time preference. We assume that the autarkic economy will converge to a world steady state where the capital to effective ratio is given by an exogenously given world interest rate. This assumption allows us to fix the size of the capital gap between the capital to effective labor ratio in autarky and the capital to effective labor ratio implied by the world interest rate under integration. This setup assumes that an economy instantaneously converges to its steady state when it opens up. We make this assumption to abstract from speed of convergence issues. The model apparatus is then used to quantify the Hicksian consumption equivalent welfare gain from moving to financial integration from autarky.

In the neo-classical framework the increase in growth following capital account liberalization is a transitory phenomenon driven by a windfall accumulation of capital. The neo-classical model predicts that capital account liberalizations lead to a permanent increase in the level of the capital stock. The decline in the interest rate brought about by capital account liberalization leads the economy to transition to its steady state level of capital immediately. Along the transition path, capital grows temporarily at a higher rate. Once the economy reaches its steady state implied by the world interest rate, the level of the capital stock is permanently higher. The temporary increase in the growth rate of capital thus leads to a permanent increase in the level of the capital stock.

Once the capital-output ratio adjusts from its initial level to the level predicted by an integrated equilibrium, the steady state growth rate in the liberalizing economy returns to its growth rate in autarky. Therefore while capital account liberalization leads to a permanent increase in the level of per capita output, the growth effect is only transitory.

The temporary growth effect prediction of the neo-classical model suggests examining transition dynamics to judge the value of liberalization more accurately. In looking at transitional short-term effects an obvious question is whether these effects are economically meaningful. In other words, how do we quantify the welfare gains from capital account liberalization? By recognizing that theory only predicts a temporary growth effect from liberalization, we can identify the timing of the increase in growth and measure its impact on welfare.

Computationally, the point is a simple one. If the increase in growth is temporary and occurs in the early years following the policy change, measuring the percent increase in annual consumption relative to the infinite horizon consumption stream results in the welfare gains from capital account liberalization being very small. However, when the percent increase in annual consumption is viewed in relation to a shorter finite horizon consumption stream, the welfare effects of liberalization are quite considerable. The reason is that a very large fraction of the benefits of opening up happen in the early years.

To quantify the temporary growth effect, we begin by asking, what is the capital to effective labor ratio implied by an exogenously given world interest rate? The answer to this question determines how much the autarkic capital to effective labor ratio will change for an exogenously given world interest rate when a country opens up. We use the change in the capital to effective labor ratio to evaluate the welfare implications of capital account liberalization. The welfare effects of moving from autarky to an open capital account depend of the size of the capital gap, i.e., the difference between the capital to effective labor ratio in autarky and under financial integration. The degree of capital scarcity in autarky is used to evaluate the welfare benefits of capital account liberalization across different horizons. We find that 95% of the increase in annual consumption from capital account liberalization accrues in the first 10-15 years after the opening.

The finite horizon methodology for measuring welfare gains tells us the amount of compensation people would require to make them indifferent between implementing liberalization or not. For example, in the first ten years, what is the percent change in autarkic consumption that agents would need to be compensated in order to not implement the policy? Our estimates show that in the first few years, people require large amounts of compensation in order to make them indifferent between implementing the policy change or not. The large initial impact of the policy change drives this finding.

Evaluating welfare gains from liberalizations under an infinite time horizon underestimates the gains enjoyed in the decades immediately following liberalization. This is because differences in the consumption paths of autarky and integration are largest soon after liberalization, yet they comprise a small portion of welfare gains when calculated using the infinite stream of consumption.

It is important to note that permanent growth effects are caused by an increase in TFP changes and in the context of the neo-classical growth model, TFP changes are independent of the capital account regime. Since cross sectional regressions test whether liberalizations lead to a permanent growth effect, it is not surprising that they do not find a significant relationship.

We implement a number of additional tests to examine the robustness of our results. First, we examine the assumption made about the nature of the evolution of the interest rate across time in the autarkic economy versus the integrated economy. The baseline model calls for absolute convergence to a world steady state pinned down by the world interest rate, we perform an additional computation assuming conditional convergence. We use stock market data to use country-specific earnings price ratios as a measure of the capitalization rate.

Second, we account for the financing cost of capital inflows. The magnitude of the welfare gain from liberalization is affected by the cost associated with liberalizing the capital account. Capital that flows into a newly liberalized economy is not costless. If this capital is in the form of debt, interest repayments must be made in the future. This will impact domestic consumption under integration and thus, welfare. In the baseline model we assume that the infinitely-lived economy services the capital it borrows from the rest of the world to finance its instantaneous convergence to the world steady state as interest payments in perpetuity. Here, the principal is never paid off. In order to quantify the net benefits of capital account liberalization we examine alternative financial contracts. We examine the baseline and alternative debt contracts of varying horizons to quantify the costs of capital account liberalization and their impact on finite horizon welfare gains in liberalizing economies.

The paper is organized as follows. Section 2 presents a brief sketch of an infinite-horizon Ramsey model. Section 3 quantifies the Hicksian consumption equivalent welfare gains from capital account liberalization in the infinite and finite horizons. Section 4 presents extensions and robustness checks. Section 5 concludes.

2 An Infinite-Horizon Ramsey Model: The Baseline Model

Our baseline model is an infinite-horizon Ramsey model to examine the gains from a shift from financial autarky to openness to international capital flows. Production is Cobb-Douglas. Raw labor grows at the population growth rate n. Labor-augmenting technical change grows increases the ratio of effective labor to raw labor at a rate of g. The rate of pure time preference is ρ . The discount factor is thus $\beta = \frac{1}{1+\rho}$. The rate of capital depreciation is δ.

We calculate the welfare benefits of capital account liberalization in terms of a Hicksian equivalent variation defined as the percentage increase in lifetime consumption an autarkic economy would enjoy as a result of liberalization. As a baseline, we assume that the autarkic interest rate converges to the world interest rate meaning that the autarkic economy eventually reaches the same steady state level of capital as the liberalized economy. Capital account liberalization in this framework, therefore, serves to expedite a country's convergence to its own steady state.

To understand how the time horizon affects the measurement of welfare, we begin by outlining our baseline model and highlighting the measure of welfare for an infinite time horizon.Consumers maximize the infinite sum of their discounted utility from consumption as follows:

$$U_t = \sum_{s=0}^{\infty} \beta^s N_(t+s) u(c_{t+s}) \tag{1}$$

subject to:

$$\tilde{c}_t + ng\tilde{k}_{t+1} = f(\tilde{k}_t) + (1-\delta)\tilde{k}_t \tag{2}$$

Using $f(\tilde{k}_t^{\alpha}) = \tilde{k}_t^{\alpha}$ and $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, the first order conditions are:

$$R_t = \alpha\tilde{k}_t^{\alpha-1} + 1 - \delta \tag{3}$$

$$\tilde{c}_t = (\beta R_{t+1})^{\frac{-1}{\gamma}} g\tilde{c}_{t+1} \tag{4}$$

β, N, and c are the discount factor, population, and per-capita consumption, respectively. $\tilde{k}$ and $\tilde{c}$ are capital and consumption detrended from population and technological growth. At the steady state, the world interest rate is equal to: $R^* = \frac{g^{\gamma}}{\beta}$. Our baseline assumption of absolute convergence means that the domestic interest rate converges to a long run interest rate R^*, which is the same as the world interest rate by assumption.

$$\lim_{t\to\infty} R_t = R^* = R_w^* \tag{5}$$

The assumption made in (5) has significant implications for the impact of capital account liberalization. Consider two economies, one in autarky and the other that liberalizes. Assume that both economies have the same initial capital stock, $\tilde{k}_0$. The capital stock in the autarkic economy evolves according to (2), (3), and (4) until it eventually reaches its steady state $\tilde{k}^*$. At this steady state, the interest rate is equal to its long run value R^* which according to (5) is also equal to the world interest rate R_w^*. Because of this, the steady state of the autarkic economy is the same as the steady state of the rest of the world. Consumption in the autarkic economy endogenously reaches $\tilde{c}_w^*$.

A financially integrated economy faces the world interest rate, R_w^*, directly upon liberalization. Capital flows into the liberalizing economy and the steady state $\tilde{k}_w^*$ is reached instantly. Since the steady state level of capital is identical to that of the autarkic economy, capital account liberalization serves to expedite an economy's movement towards its own (world) steady state. Figure 1 shows the consumption path of an economy in autarky and integration assuming that the capital inflow upon liberalization was costless. Of course, capital that flows into a newly liberalized economy is not costless.

As a baseline we assume that the infinitely-lived economy services the capital it borrows from the rest of the world to finance its instantaneous convergence to the world steady state as interest payments in perpetuity. Therefore steady state consumption under integration is reduced by these payments every period. Figure 2 presents a graphical representation of the results. Note that the consumption stream under integration is lower than in Figure 1 because of the financing costs associated with financial liberalization.

3 Are Transitional Growth Effects Economically Meaningful?

In looking at transitional short-term effects an obvious question is whether these effects are economically meaningful. In other words, what is the magnitude of the welfare gains from capital account liberalization? We answer this question using different time horizons to better assess the welfare impact of the transitional short term effects of liberalization.

3.1 The Magnitude of Welfare Gains in the Infinite Horizon

We measure the gains from liberalization in terms of a Hicksian equivalent variation, μ, which is the percentage increase in lifetime consumption it would take to equate the welfare of the autarkic economy to that of the liberalized economy. Welfare is calculated as the lifetime utility from the optimal consumption path, $U_t = \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t)$. Hence, welfare in the autarkic economy and integrated economy is calculated as $U_{aut} = \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{aut})$ and $U_{int} = \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{int})$, respectively. Thus, calculating μ involves equating the following:

$$\sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{aut}(1+\mu)) = \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{int})$$

This leads to the following expression for mu:

$$\mu = exp[(1-\beta n)(U_{int} - U_{aut})] - 1 \tag{6}$$

Which is derived in the following manner :

$$\sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{aut}(1+\mu)) = \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{int})$$

$$\sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{aut}) + log(1+\mu)\sum_{t=0}^{\infty}(\beta n)^t = \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{int})$$

Table 1: Parameters

Discount factor	β	0.96
Capital share in production	α	0.3
Depreciation rate	δ	0.06
Output growth rate	g	1.012
Population growth rate	n	1.022
CRRA	γ	1

$$log(1+\mu)\sum_{t=0}^{\infty}(\beta n)^t = \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{int}) - \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{aut})$$

$$log(1+\mu) = \frac{\sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{int}) - \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{aut})}{\sum_{t=0}^{\infty}(\beta n)^t}$$

$$\mu = exp\left(\frac{\sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{int}) - \sum_{t=0}^{\infty}(\beta n)^t log(g^t \tilde{c}_t^{aut})}{\sum_{t=0}^{\infty}(\beta n)^t}\right) - 1$$

$$\mu = exp[(1-\beta n)(U_{int} - U_{aut})] - 1$$

Since

$$\sum_{t=0}^{\infty}(\beta n)^t = 1/(1-\beta n)$$

Using the parameter values in Table 1, we calibrate the consumption paths of the autarkic and integrated economies in order to calculate μ. Using the population weighted average capital stock in 1995 as the initial level of capital, the autarkic economy will climb from the resulting initial level of capital, 1.96, to the steady state level of capital, 3.97. We compute the optimal consumption path by Euler equation iteration in the de-trended version of the representative agent problem .

In the case of capital account liberalization, the economy is assumed to enjoy the world interest rate R_w^* from the onset, it is thus at steady state from the initial period onward. This also means that consumption is at its steady state level, minus interest repayment, from the initial period onward.

3.2 The Magnitude of Welfare Gains in the Finite Horizon

The measure for welfare gain, μ, as calculated in (6), finds the permanent percent increase in autarkic consumption that would equate welfare in the autarkic economy to welfare in the integrated economy in the infinite horizon. In other words, if the autarkic economy liberalized its capital account, it will enjoy μ percent more consumption every period, forever. Intuitively, calculating μ involves measuring the welfare from the infinite streams of integrated and autarkic consumption, U_{int} and U_{aut} respectively, and backing out the percentage by which each observation in the infinite autarkic consumption stream must increase in order to equate the welfare in autarky to the welfare under integration.

From the formulation of capital account liberalization presented above, we know that the difference between the autarkic and integrated consumption streams come from the pre-convergence segment of the two streams. In the baseline model, after the autarkic economy converges to the steady state, its consumption stream is the same as that of the integrated economy less interest payments (Figure 2).

The same welfare measure calculated using the infinite streams of consumption is used to calculate the percentage increase in autarkic consumption resulting from liberalization in the finite horizon. Since the majority of the difference in the autarkic and integrated consumption streams occurs before convergence, the difference between welfare calculated using the infinite streams of consumption comes about because of that small, finite, pre-convergence portion of the infinite streams of consumption.

In the infinite horizon setup, the difference in welfare arising from these finite segments is used to calculate the percentage increase, μ, for the entire stream of autarkic consumption over the infinite horizon. In other words, the percentage increase in consumption for an infinite stream is calculated using the welfare difference coming from a finite segment of the infinite stream of consumption. The farther out consumption is in the future, the more it is discounted making the value of μ small.

In order to address the horizon issue, we can calculate μ for a finite horizon as the percentage by which autarkic consumption must increase in a finite time period following liberalization in order to equate autarkic and integrated welfare over that same finite time period. Let welfare be measured up to time T where $t \leq T$ and denote the percentage change in consumption by μ_T [1]. We know that μ_T is calculated such that welfare in autarky and integration over that finite time period are equivalent in a Hicksian sense. Thus:

$$\sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{int}(1+\mu_T)) = \sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{aut})$$

This leads to the following expression for μ_T:

$$\mu_T = exp\left(\frac{1-\beta n}{1-(\beta n)^{T+1}}(U_{int} - U_{aut})\right) - 1 \tag{7}$$

which is derived as follows:

$$\sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{int}(1+\mu)) = \sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{aut})$$

[1] The argument holds for $t^* \geq T$ as well. Explaining the intuition behind μ_T is more involved when $t^* \leq T$, which is why that is the case presented above.

$$\sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{aut}) + log(1+\mu)\sum_{t=0}^{T}(\beta n)^t = \sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{int})$$

$$log(1+\mu)\sum_{t=0}^{T}(\beta n)^t = \sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{int}) - \sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{aut})$$

$$log(1+\mu) = \frac{\sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{int}) - \sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{aut})}{\sum_{t=0}^{T}(\beta n)^t}$$

$$\mu = exp\left(\frac{\sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{int}) - \sum_{t=0}^{T}(\beta n)^t log(g^t \tilde{c}_t^{aut})}{\sum_{t=0}^{T}(\beta n)^t}\right) - 1$$

$$\mu_T = exp\left(\frac{1-\beta n}{1-(\beta n)^{T+1}}(U_{int} - U_{aut}\right) - 1$$

Since

$$\sum_{t=0}^{T}(\beta n)^t = \frac{1-(\beta n)^{T+1}}{1-\beta n}$$

Notice that in equation (7),$(U_{int} - U_{aut}) = \sum_{t=0}^{t^*}(\beta n)^t log(g^t \tilde{c}_t^{int}) - \sum_{t=0}^{t^*}(\beta n)^t log(g^t \tilde{c}_t^{aut})$ just as in (6). This is because the only gain in welfare occurs before convergence; autarkic and integrated consumption streams from t^* to T are equal. Yet, there is a difference in the way this gain in welfare is weighed and this is reflected by the inverse of the finite geometric sum of the discount factor multiplied by the population growth rate, $\frac{1-\beta n}{1-(\beta n)^{T+1}}$. Since $\beta n < 1$ we know that $(1-\beta n) < \frac{1-\beta n}{1-(\beta n)^{T+1}}$; therefore, $\mu < \mu_T$. Intuitively, this result makes sense because we are trying to translate the welfare gain $(U_{int} - U_{aut})$, which is identical in both the infinite horizon and the finite horizon ending at T, into a percentage increase in autarkic consumption for a finite stream of consumption, μ_T , rather than a percentage increase in autarkic consumption for an infinite stream of consumption, μ. Table 2 illustrates this point for a sample of 81 non-OECD countries.

This alternative measure of the increase in welfare, μ_T, takes into account the timing of the gains from liberalization and would be better suited to evaluate certain liberalization policies. We know that the lion's share of the gain in welfare from liberalization occurs in the short run. Thus, in evaluating the benefit from liberalization, we would like to know what the percentage increase in autarkic consumption would be for the observations before convergence. A quick comparison to μ shows that it underestimates the short run benefits of liberalization.

In Table 2, the cost of capital to the newly integrated economy is $(\tilde{k*} - k_0) * (1 - R*)$. The integrated economy pays interest on the inflow of capital in perpetuity. For the sample of 81 non-OECD countries, the infinite horizon average μ is -3.4642% increase in annual consumption. This means that the cost of financing financial liberalization outweighs the benefit of a short run increase in consumption. In contrast, the five year finite horizon μ_T is an order of magnitude higher at 19.0225%. As the

Table 2: Welfare Gains Over Finite Horizons

	Average	Quartiles			
		First	Second	Third	Fourth
Pop. Weighted Average k_0	1.96	0.75	1.67	2.65	4.12
Time Horizon (Years)			μ_T		
5	19.02	51.47	24.04	10.29	-0.90
10	12.49	31.97	15.67	6.80	-0.62
15	7.89	20.25	9.93	4.21	-0.40
20	4.82	13.01	6.16	2.43	-0.24
25	2.71	8.25	3.59	1.18	-0.12
30	1.21	4.94	1.77	0.29	-0.04
35	0.11	2.54	0.43	-0.37	0.01
40	-0.72	0.74	-0.57	-0.87	0.06
45	-1.37	-0.65	-1.36	-1.27	0.10
50	-1.89	-1.75	-1.98	-1.58	0.12
∞	-3.46	-4.95	-3.88	-2.47	0.22

Notes - μ_T reported in percentage points. Data are for 81 non-OECD countries. We use the population weighted capital stock in 1995 for the initial level of capital. The sample is also divided into quartiles based on the size of the capital stock in 1995.

finite horizon increases, consistent with theory μ declines as the autarkic consumption path converges to its steady state value closing the gap between the instantaneous increase in consumption afforded by integration.

Table 2 also shows that the magnitude of the finite horizon increase in welfare represented by μ_T is directly proportional to the size of the capital gap between autarky and integration. Appendix A lists countries by initial capital stock values by quartile. For the highly capital-scarce countries in the first quartile of initial capital stock values k_0, the finite horizon μ_T at five years is a 51.47% increase in annual consumption. For non-OECD countries that are relatively more capital-abundant, the five year finite horizon μ_T is a decline in annual consumption of -0.90% for countries in the fourth quartile of initial capital stock values.

The short run representation of the welfare gain captures the increase in welfare due to the timing of the increase in consumption. Under the assumption that the newly integrated economy will instantaneously enjoy the steady state consumption level, less interest payment, the finite horizon calculation of μ measures this instant increase upon liberalization. It is clear that the shorter the horizon, the larger the measure of the welfare gain from liberalization.

Table 3: Welfare Gains Using $\frac{E}{P}$ Ratio

	First	Second	Third	Fourth
$\frac{E}{P} - r^*$	-0.018	-0.005	0.010	0.037
Time Horizon (Years)		μ_T		
5	15.31	13.71	12.14	9.89
10	8.40	6.68	5.02	2.68
15	3.95	2.32	0.77	-1.36
20	1.12	-0.38	-1.81	-3.74
25	-0.76	-2.17	-3.48	-5.26
30	-2.08	-3.40	-4.63	-6.29
35	-3.03	-4.29	-5.46	-7.02
40	-3.75	-4.95	-6.07	-7.57
45	-4.30	-5.47	-6.55	-7.99
50	-4.74	-5.88	-6.93	-8.33
∞	-5.63	-6.49	-7.29	-8.35

Notes - μ_T reported in percentage points. Data on $\frac{P}{E}$ ratios are from the Emerging Markets Data Base. The sample is also divided into quartiles based on the size of the premium $R_i^* - R^*$. Details on the countries is included in Appendix B. $k_0 = 1.96$ and $n = 1.022$ the population weighted initial capital stock and population growth rate for the non-OECD countries in the study. The cost of repayment in the same as that in the baseline.

4 Extensions and Alternative Mechanisms

4.1 Conditional Convergence

We examine the assumption made about the nature of the evolution of the interest rate across time in the autarkic economy versus the integrated economy. Thus far, we have examined financial liberalization under the assumption of absolute convergence to a world steady state pinned down by the world interest rate. Here we consider conditional convergence, meaning that countries' interest rates may not necessarily converge to a common world interest rate. We use country-specific earnings price ratios from stock market data as a measure of the capitalization rate. Table 3 shows the results.

Assuming conditional convergence allows for cross country heterogeneity, in educational attainment, fertility decisions, technology, and institutions, that would make the steady state levels of capital of countries differ [Barro and Sala-i Martin (1992)]. Here, upon liberalization, instead of a country moving to a steady state which is the same as the world steady state, it moves to its own unique steady state. Recall that the steady state capital is determined by $k_i^* = \left(\frac{\alpha}{R_i^* - \delta - 1}\right)^{\left(\frac{1}{1-\alpha}\right)}$. Under conditional convergence, the country specific interest rate R_i^* determines a country specific steady state level of capital. When a country's interest rate R_i^* is lower than the world interest rate R^*, the steady state level of capital for that country is higher than the world steady state level of capital. This means that the welfare effect of liberalization under conditional convergence will be higher than under absolute convergence. Liberalization here means that the economy converges faster to a higher steady state. The opposite is true for an economy where the interest rate is lower than the world interest rate.

The premium in Table 3 is $R_i^* - R^*$. With the calibration in Table 1, the world interest rate, R^*, is approximately 5.42%. When the premium is negative, the steady state level of capital that the country is converging to is higher than the world steady state level of capital. Liberalization will allow these countries to reach that higher steady state of capital faster. The opposite is true when the premium is positive: the country's steady state level of capital is lower than the world steady state level of capital. Upon liberalization this country will converge to a lower steady state and it will experience lower welfare than under the assumption of absolute convergence. Table 3 shows the results across default quartiles for the risk premium. As expected, the shorter the horizon for which it is measured the higher the value of μ.

4.2 Alternate Financial Contracts

We also account for the financing cost of capital inflows. Capital that flows into a newly liberalized economy is not costless. The magnitude of the welfare gain from liberalization is affected by the cost associated with liberalizing the capital account. In order to quantify the net benefits of capital account liberalization we examine alternative financial contracts. Recall that the baseline model assumes that the infinitely-lived economy services the capital it borrows from the rest of the world to finance its instantaneous convergence to the world steady state as interest payments in perpetuity. Here, the principal is never paid off. We examine alternative debt contracts to quantify the costs of capital account liberalization and their impact on finite horizon welfare gains in liberalizing economies.

Infinite horizon model in Obstfeld-Rogoff (1996). In an infinite horizon problem, the transversality condition implies that:

$$\lim_{T\to\infty}\left(\frac{1}{\beta}\right)^T B_{t+T+1} = 0$$

This means that after substituting for B_t in the per period budget constraint and solving for steady state consumption we get $RB_t = C_t + I_t - Y_t + B_{t+1}$ and steady state consumption is given by:

$$\overline{C} = \frac{R-1}{R}\left(RB_t + \lim_{T\to\infty}\left(\frac{1}{\beta}\right)^t (\overline{Y} - \overline{I})\right)$$

We return to a benchmark economy with an initial population weighted average initial capital level of 1.96 and impose the transversality condition which holds if and only if the economy in the infinite horizon has neither unpaid debts nor unused resources to compute the welfare gains across different horizons. Here, both the principal and interest are paid off at infinity. The welfare estimates are

Table 4: Welfare Gains: Obstfeld-Rogoff

	Average	Quartiles			
		First	Second	Third	Fourth
Pop. Weighted Average k_0	1.96	0.75	1.67	2.65	4.12
Time Horizon (Years)			μ_T		
5	29.32	74.25	36.56	16.39	-1.48
10	23.14	53.76	28.45	13.26	-1.25
15	18.45	40.77	22.48	10.71	-1.04
20	15.25	32.63	18.48	8.93	-0.89
25	13.03	27.23	15.73	7.67	-0.79
30	11.44	23.47	13.78	6.75	-0.71
35	10.27	20.73	12.34	6.07	-0.65
40	9.39	18.68	11.25	5.56	-0.61
45	8.70	17.08	10.40	5.15	-0.57
50	8.15	15.82	9.73	4.83	-0.54
∞	4.97	7.87	5.79	2.94	-0.42

Notes - μ_T reported in percentage points. Data are for 81 non-OECD countries. We use the population weighted capital stock in 1995 for the initial level of capital. The sample is also divided into quartiles based on the size of the capital stock in 1995.

presented in Table 4.

The economy in the infinite horizon has neither unpaid debts nor unused resources. If the repayment occurs far enough into the future, it will not affect welfare in a drastic way because the discount factor will be very high. Comparing Table 4 to Table 2, we can see that the welfare gains here are positive even at infinity (except for initial capital stocks in the fourth quartile). Unlike the case with making repayments in perpetuity, here, the government may schedule repayments to begin farther into the future. Using this mode for repayment we only care about the resolution of debt by infinity, without specifying the way repayments are distributed in the interim. The next section focuses on the way repayments are allocated through time.

50 year debt contract. Consider an alternative debt contract with a finite, 50 year repayment horizon where once again both principal and interest are paid off. If external debt is amortized in equal payments over 50 years, then annual amortization will be $(\tilde{k*} - \tilde{k_0}) * (\frac{r^*(1+r^*)^{50}}{(1+r^*)^{50}-1})$, for $t \leq 50$ and zero thereafter (where $r^* = 1 - R^*$ is the world interest rate). The results are presented in Table 5.

Consider the results in Table 5. μ at the infinite horizon is negative, however, the short run calculations for μ are positive and large and slowly become negative for all quartiles except the fourth. The value of μ depends on the size of the initial capital inflow. Consider the fourth quartile, where the initial level of capital is the highest. Since the initial level of capital is close to the steady state level, in the short run, upon liberalization, the repayment associated with the capital inflow will cause the

Table 5: Welfare Gains: 50 Year Debt Contract

	Average	Quartiles			
		First	Second	Third	Fourth
Pop. Weighted Average k_0	1.96	0.75	1.67	2.65	4.12
Time Horizon (Years)			μ_T		
5	18.22	49.69	23.07	9.82	-0.86
10	11.66	30.28	14.67	6.30	-0.57
15	7.07	18.66	8.96	3.71	-0.35
20	4.02	11.49	5.21	1.93	-0.19
25	1.92	6.78	2.65	0.68	-0.07
30	0.42	3.51	0.84	-0.20	0.01
35	-0.67	1.13	-0.48	-0.87	0.06
40	-1.50	-0.64	-1.49	-1.37	0.11
45	-2.15	-2.02	-2.27	-1.77	0.15
50	-2.67	-3.11	-2.89	-2.08	0.18
∞	-4.12	-5.97	-4.63	-2.89	0.27

Notes - μ_T reported in percentage points. Data are for 82 non-OECD countries. We use the capital stock in 1995 for the initial level of capital. The sample is also divided into quartiles based on the size of the capital stock in 1995.

consumption stream under integration to be lower than the consumption stream under autarky, making μ negative. However, because the amount these countries had to borrow was low, the payments are small and eventually the consumption stream under integration will become higher than under autarky. Conversely, for all other quartiles, the initial level of capital is much lower than the steady state level. In the short run, the consumption stream under liberalization, even after repayment, will be higher than that under autarky, contributing to the positive μ. However, since the amount initially borrowed was large, the cost of repayment catches up with the economy later, eventually causing the level of consumption under liberalization to be lower than autarky, contributing to the negative μ.

As can be noted by the negative values in Table 5, the way financing costs are repayed greatly influences the welfare effect of financial liberalization. If the bulk of the repayment occurs far enough into the future the short run welfare gain will be larger. Conversely, when the repayment of debt is spread out evenly across states (Table 2) or front loaded (Table 5) the gain in welfare will be lower. This brings to attention the importance of considering the allocation of the costs from financial liberalization across time. When measuring welfare using a short run horizon, these effects will be amplified.

Capital from 1960. We also conduct the welfare analysis by initiating the autarkic economy using initial capital stock values from 1960 rather than 1995 (GJ formulation). By 1995 a number of countries had already implemented capital account liberalization policies. Therefore characterizing the capital stock values for non-OECD economies in 1960 may be a more realistic representation of economies in

Table 6: Welfare Gains Over Finite Horizons

	Average	Quartiles			
		First	Second	Third	Fourth
Sample Average k_0	1.81	0.65	1.20	1.88	3.35
Time Horizon (Years)			μ_T		
5	32.03	59.59	38.21	24.64	8.07
10	22.85	41.59	27.65	18.11	5.74
15	16.92	30.47	20.58	13.59	4.30
20	13.11	23.52	15.97	10.57	3.36
25	10.55	18.93	12.84	8.50	2.72
30	8.75	15.73	10.63	7.02	2.26
35	7.43	13.41	9.02	5.93	1.92
40	6.44	10.67	7.80	5.10	1.67
45	5.67	10.32	6.85	4.45	1.47
50	5.06	9.26	6.10	3.94	1.31
∞	1.47	3.08	1.68	0.90	0.36

Notes - μ_T reported in percentage points. Date are for 82 non-OECD countries. We use the capital stock in 1960 for the initial level of capital. The average level of initial capital at 1960 across countries is 1.81. The sample is also divided into quartiles based on the size of the capital stock in 1995.

autarky. The results suggest that the gains from capital account liberalization over finite horizons are even larger in magnitude. This is not surprising since the size of the capital gap for most non-OECD countries was much larger in 1960.

4.3 Debt vs. Equity

Assume a technology shock that is normally distributed with mean 1 and standard deviation 0.03. While this is not a realistic shock, it is used for illustrative purposes. We introduce the shock to demonstrate the difference between financing liberalization with a non-contingent debt contract, or an equity-like contract. We calculate mu using the consumption stream in autarky where technology is subject to the same shocks as technology in integration with the consumption stream in integration. Table 7 shows the results assuming no repayment under integration as a benchmark – in practice integration is costly.

We assume that the economy will have to repay $(\tilde{k*} - k_0) * (1 - R*)$ each period under integration. With a debt contract, the economy must repay $(\tilde{k*} - k_0) * (1 - R*)$ each period, the second table shows the results. mu is calculated assuming no default translated here as forcing $c > 0$, if $c \leq 0$ I put c=0.05 a negligible amount, but it serves the purpose of calculating. Table 8 presents the results.

With an equity contract, the economy does not make payments during times with negative shocks.

Table 7: Welfare Gains: Stocastic Technology Shock with no Repayment

	Average	Quartiles			
		First	Second	Third	Fourth
Pop. Weighted Average k_0	1.96	0.75	1.67	2.65	4.12
Time Horizon (Years)			μ_T		
5	21.87	64.71	28.79	9.44	-7.26
10	12.91	41.06	17.82	3.65	-9.27
15	9.01	29.54	12.75	1.74	-8.69
20	6.24	22.24	9.24	0.28	-8.43
25	4.96	18.17	7.49	-0.13	-7.75
30	4.51	15.90	6.72	0.01	-6.92
35	4.56	14.72	6.56	0.48	-6.03
40	3.55	12.53	5.35	-0.15	-6.08
45	3.17	11.34	4.83	-0.26	-5.84
50	2.70	10.17	4.24	-0.51	-5.76
∞	1.49	4.93	2.37	-0.49	-4.54

Notes - The same shock hits the integrated and autarkic economy. It is normal with mean 1 and a standard deviation of 0.03. μ_T reported in percentage points. Data are for 81 non-OECD countries. We use the population weighted capital stock in 1995 for the initial level of capital. The sample is also divided into quartiles based on the size of the capital stock in 1995.

Here, for simplicity we also assume away the probability of default. The results are in table 9. As we can see, an equity contract comes close to the case of an economy that liberalizes and does not need to make repayment.

Table 8: Welfare Gains: Stocastic Technology Shock with Debt

	Average	Quartiles			
		First	Second	Third	Fourth
Pop. Weighted Average k_0	1.96	0.75	1.67	2.65	4.12
Time Horizon (Years)			μ_T		
5	-44.77	-56.97	-40.06	-53.67	-68.48
10	-63.04	-66.85	-70.15	-54.26	-66.91
15	-71.72	-69.55	-74.32	-60.19	-71.11
20	-75.04	-71.51	-76.40	-69.18	-74.21
25	-75.15	-73.19	-78.79	-72.36	-73.29
30	-76.56	-73.68	-79.28	-72.67	-74.84
35	-77.11	-73.77	-79.32	-74.47	-73.91
40	-76.19	-72.61	-78.22	-73.87	-73.94
45	-78.70	-74.09	-79.77	-76.41	-74.46
50	-80.15	-75.08	-80.76	-77.57	-74.73
∞	-74.38	-69.80	-74.56	-72.45	-71.78

Notes - The same shock hits the integrated and autarkic economy. It is normal with mean 1 and a standard deviation of 0.03. μ_T reported in percentage points. Data are for 81 non-OECD countries. We use the population weighted capital stock in 1995 for the initial level of capital. The sample is also divided into quartiles based on the size of the capital stock in 1995.

Table 9: Welfare Gains: Stocastic Technology Shock with Equity

	Average	Quartiles			
		First	Second	Third	Fourth
Pop. Weighted Average k_0	1.96	0.75	1.67	2.65	4.12
Time Horizon (Years)			μ_T		
5	26.30	70.89	33.49	13.43	-4.07
10	17.03	46.41	22.14	7.44	-6.21
15	9.97	30.73	13.75	2.64	-7.95
20	6.87	23.00	9.89	0.88	-7.93
25	5.02	18.22	7.55	-0.08	-7.68
30	4.22	15.53	6.43	-0.26	-7.09
35	3.42	13.28	5.38	-0.60	-6.79
40	3.39	12.30	5.18	-0.31	-6.15
45	3.19	11.33	4.84	-0.24	-5.78
50	3.08	10.62	4.62	-0.15	-5.46
∞	1.47	4.87	2.35	-0.50	-4.49

Notes - The same shock hits the integrated and autarkic economy. It is normal with mean 1 and a standard deviation of 0.03. μ_T reported in percentage points. Data are for 81 non-OECD countries. We use the population weighted capital stock in 1995 for the initial level of capital. The sample is also divided into quartiles based on the size of the capital stock in 1995.

5 Conclusion

This paper studies the transitional dynamics of a policy change that leads to a temporary growth effect. We find that that the methodological approach to measure the welfare impact of a policy change like capital account liberalization can drive the magnitude of policy effect estimates. Evaluating welfare gains from liberalizations under an infinite time horizon underestimates the gains enjoyed in the decades following liberalization as differences in the consumption paths of autarky and integration are large soon after liberalization. Yet these differences comprise only a small fraction of welfare gains calculated using the infinite lifetime consumption stream. Calculating welfare benefits over finite horizons may be more appropriate and policy-relevant for evaluating policy changes such as capital account liberalization that lead to temporary growth effects but permanent level effects on per capita incomes.

We do not claim that policies that lead to permanent effects on TFP and growth are not important. We simply point out that policy changes that lead to temporary growth but permanent level effects of this sort (like capital account liberalization) can add up to significant increases in levels of per capita incomes. Examining the welfare consequences of a temporary growth (and permanent level) effect is also the more consistent way of testing the predictions of the neo-classical growth model in the context of capital account liberalization.

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Figure 1: Consumption Streams in Autarky and Integration

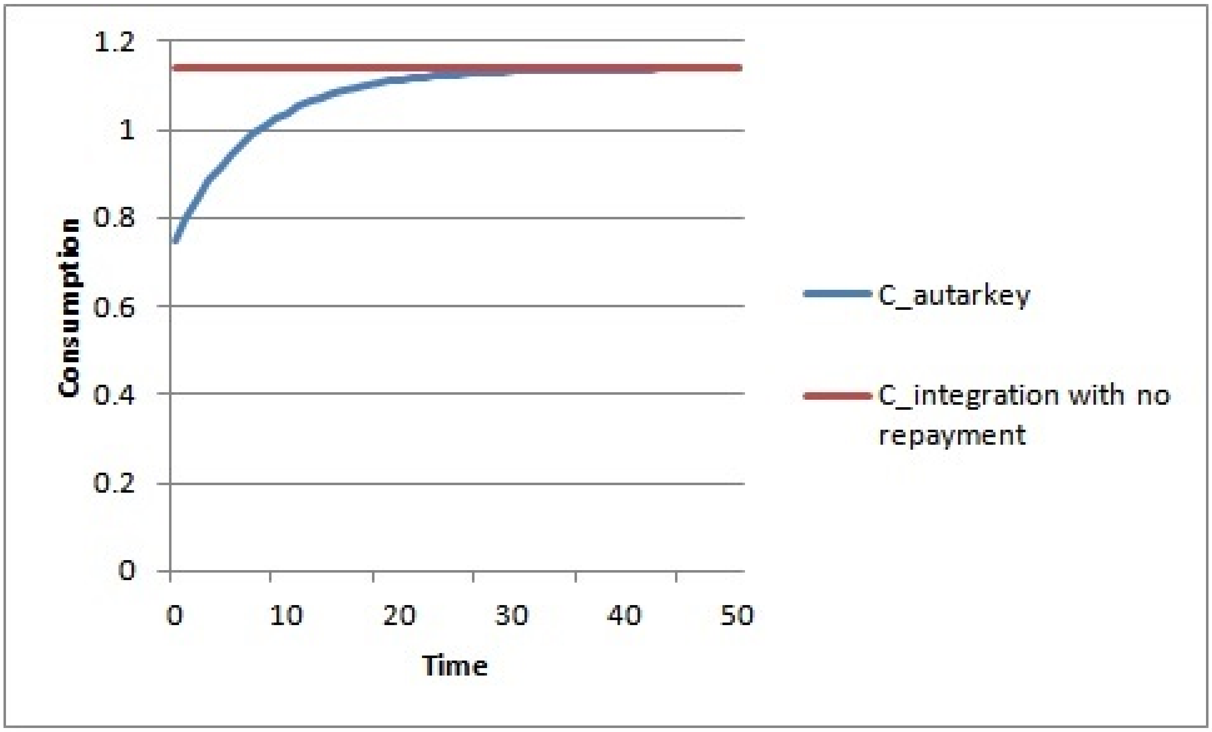
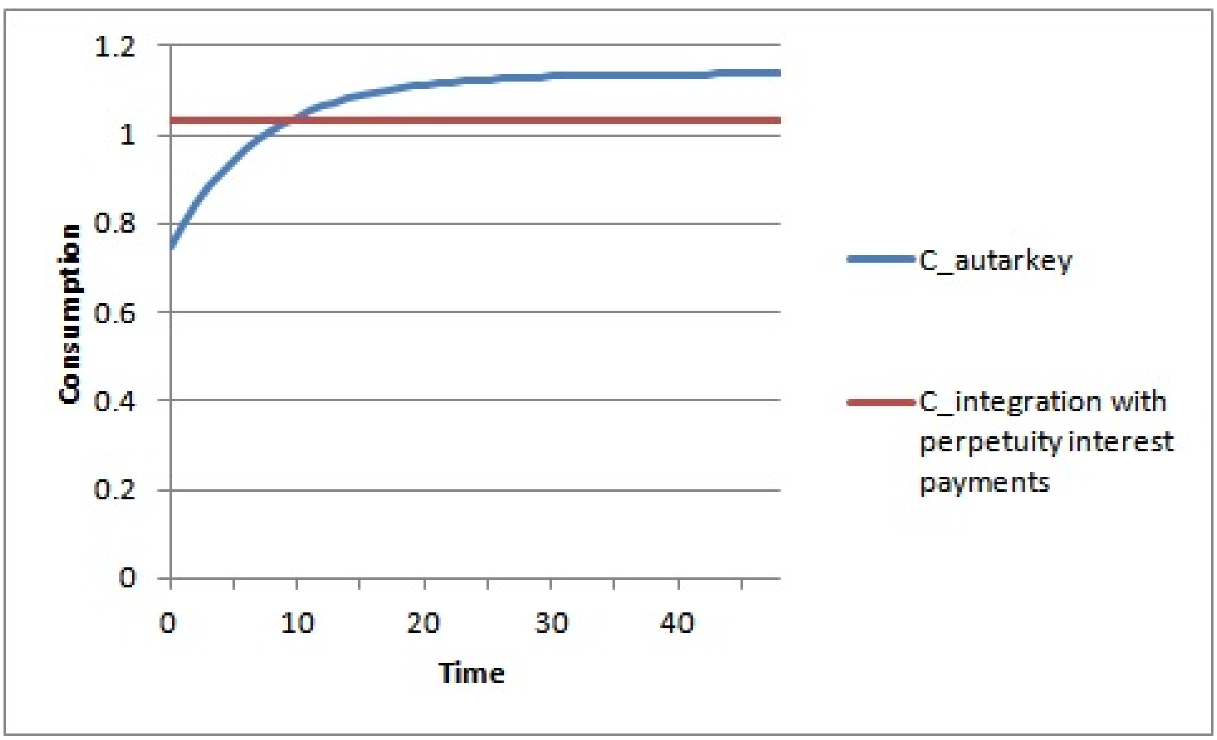


Figure 2: Consumption Streams in Autarky and Integration: Baseline



Appendix A

Quartiles by Capital to Output Ratio in 1995 for Non-OECD Countries

First	Second	Third	Fourth
Uruguay	Chad	Botswana	Ghana
Mexico	Panama	Chile	Phillipines
Mauritania	Bolivia	Republic of Congo	Hong Kong
Ethiopia	Zambia	Costa Rica	Paraguay
El Salvador	Cape Verde	Cyprus	Pakistan
Senegal	Rwanda	Papua New Guinea	Ethiopia
Benin	Lesotho	Tanzania	Trinidad and Tobago
Guinea	Malawi	Iran	Jamaica
Cote d'Ivoire	Togo	Niger	Syria
Central Africa	Angola	South Africa	Dominican Republic
Singapore	Malaysia	Peru	Sri Lanka
Burundi	Colombia	Argentina	Uganda
Guyana	Tunisia	Egypt	Guatemala
Nicaragua	Guinea-Bissau	Ecuador	Israel
Mauritius	Democratic Republic of Congo	Zimbabwe	Gabon
Nigeria	Algeria	Brazil	Fiji
Thailand	Indonesia	Mali	Sierra Leone
Mozambique	China	Honduras	Nepal
Bangladesh	Indonesia	Morocco	Republic of Korea
Burkina Faso	Madagascar	Venezuela	Switzerland
Cameroon	Barbados		

Appendix B

Quartiles by Capital to Output Ratio in 1995

First	Second	Third	Fourth
Mexico	Philippines	Argentina	Colombia
Malaysia	Korea	Peru	Sril Lanka
Thailand	South Africa	Pakistan	Zimbabwe
Indonesia	Chile	India	Greece
Brazil	Portugal	Venezuela	Turkey

Notes - μ_T reported in percentage points. Data on $\frac{P}{E}$ ratios are from the Emerging Markets Data Base. The sample is also divided into quartiles based on the size of the premium $R_i^* - R^*$.