Does Capital Scarcity Matter?

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Abstract

This paper quantifies the welfare impact of a permanent increase in the level of per capita income brought about by a temporary growth effect following financial liberalization. We find that a lion's share of the welfare benefits from financial liberalization accrue over relatively short horizons, and in the early years after the policy is implemented. Evaluating welfare gains from liberalizations under an infinite time horizon underestimates the gains enjoyed in the early years following liberalization as differences in the consumption paths in autarky and integration are large soon after liberalization. Yet the welfare impact of these differences is small when welfare gains are calculated using infinite horizon consumption streams. Calculating welfare benefits over finite horizons may be more appropriate and policy-relevant for evaluating policy changes such as financial liberalization that lead to temporary growth effects but permanent level effects on per capita incomes.

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1. Introduction

The neo-classical model predicts that financial liberalization can increase allocative efficiency by allowing capital to flow from countries where it is abundant to countries where it is scarce. Capital flowing into liberalizing economies lowers the cost of capital, increases investment and economic growth leading to a permanent increase in the standard of living (Fisher 1998, 2003; Obstfeld, 1998; Rogoff, 1999; Summers, 2000; Henry, 2007).

Research on the macroeconomic impact of capital account liberalization finds few, if any, robust effects of liberalization on real variables (i.e. investment and GDP per capita). Henry (2007) demonstrates that the prevailing null effect findings should not be regarded as conclusive because most papers employ cross-sectional regressions designed to measure long-run permanent differences in growth rates in economic variables of interest (See surveys by Edison, Klein, Ricci, and Slok, 2004 and Prasad, Rogoff, Wei, and Kose, 2003 and the studies therein). In contrast, textbook theory of liberalization calls for a temporary rather than a permanent growth effect (Henry, 2007). Therefore, the predictions of the neo-classical model are not undermined by cross-sectional regressions that do not find permanent growth effects.

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 financial liberalization. If agents are infinitely-lived, the increase in consumption (welfare) brought about by financial liberalization may not be quantitatively important over the infinite lifetime consumption path (Gourinchas and Jeanne, 2006). However, if a lion's share of the welfare benefits from financial liberalization accrue over relatively short horizons, and in the early years after the policy is implemented, calculating the welfare benefits over a finite horizon may be more appropriate, and policy-relevant.

To see why, in the neo-classical framework the increase in growth following financial 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 steady state capital stock. The decline in the interest rate brought about by capital account liberalization leads the economy to transition to a new steady state. Along the transition path, capital grows temporarily at a higher rate. Once the economy reaches the new steady state implied by financial integration, the level of the capital stock has increased permanently. The temporary increase in the growth rate of capital thus leads to a permanent increase in the level of the capital stock.

Simultaneously the growth rate of output increases as the economy transitions from its autarky steady state to an integrated steady state. Once the capital-output ratio adjusts from its level in autarky to the level predicted by an integrated equilibrium, the steady state growth rate in the liberalizing economies

returns to its growth rate in autarky. Therefore while financial 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 more accurately the value of financial liberalization. In looking at transitional short-term effects an obvious question is of course whether these effects are economically meaningful. In other words, how do we quantify the welfare gains from financial liberalization? By recognizing that theory only predicts a temporary growth effect from financial 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 financial 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 financial 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 capital to effective labor ratio in autarky will have to change for an exogenously given world interest rate when a country opens up. Depending on the magnitude, the change in the capital to effective labor ratio can be used to evaluate the welfare implications of capital account liberalization. The welfare effects of moving from autarky to an open capital account will therefore 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 financial liberalization.

We use the apparatus in Gourinchas and Jeanne (2006) 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 which depends on the rate of time preference. It is assumed 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. In this setup it is assumed that when an economy opens up it instantaneously converges to its steady state. 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.

We find that 95% of the benefits of the opening up accrue in the early years. A lion's share of the increase in annual consumption from financial liberalization accrues in the first 10-15 years after the policy is implemented.

The finite horizon methodology to measure welfare gains provides insights about how much agents would have to be compensated to not implement financial liberalization. For example, in the first ten years, what is fraction of the present discounted value of 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, agents would have to be compensated very highly in order to make them indifferent between implementing and not implementing the policy change. The finding stems from the fact that the initial effects of the policy change are big.

Evaluating welfare gains from liberalizations under an infinite time horizon underestimates the gains enjoyed in the decades 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.

We also do a back of the envelop calculation for the increase in per capita incomes implied by financial liberalization over different horizons for a sample country, Angola. The cumulative increase in the level of per capita income ought to be approximately 20% relative to autarky in the first 20 years following liberalization according to our estimations. The bulk of this implied increase in the level of per capita income (13%) relative to autarky is expected in the first five years following liberalization. A 7% increase in per capita income relative to autarky is expected between five and ten years and the increase ought to slow to 1.2% over autarky levels between ten and fifteen years and the difference in per capita incomes is expected to be negligible between fifteen and twenty years. These findings are consistent with a temporary growth effect following liberalization. However, all else equal, the level effect is expected to be permanent.

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. Since the Gourinchas and Jeanne (2006) framework calls for absolute convergence to a world steady state pinned down by the world interest rate, we make two additional computations. We quantify the finite horizon welfare gains with the autarkic economies

converging to the world interest rate plus some country risk premium. We also use stock market data to use country-specific earnings price ratios as a measure of the capitalization rate.

A second factor that can affect the magnitude of the welfare gain from liberalization is the cost associated with liberalizing the capital account. Capital that flows into a newly liberalized economy is not costless. Whether this capital is in the form of debt or equity, interest or dividend repayments must be made. This will impact the domestic consumption under integration and thus, welfare. We examine alternative financial contracts in order to quantify the net benefits of financial liberalization. Gourinchas and Jeanne (2006) 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 akin to equity investments. We examine alternative debt contracts of varying horizons to quantify the costs of financial 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 financial liberalization in the infinite and finite horizons. Section 4 presents robustness checks and Section 5 concludes.

2. An Infinite-Horizon Ramsey Model: The Gourinchas-Jeanne (2006) Formulation

Gourinchas and Jeanne (2006), or GJ, use 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 $\beta=1+\rho$. The rate of capital depreciation is δ.

GJ calculate the welfare benefits of financial liberalization in terms of a Hicksian equivalent variation defined as the percentage increase in consumption an autarkic economy would enjoy as a result of liberalization. The domestic autarkic interest rate is assumed to converge to the world interest rate and the autarkic economy eventually reaches the same steady state level of capital as the liberalized economy. Financial liberalization in this framework, therefore, serves to expedite a country's convergence to its own steady state.

GJ's findings suggest that in Hicksian consumption equivalent terms the welfare gains from financial liberalization are quite small. For example, a liberalization that more than doubles the capital stock of an economy leads only to a population weighted average 1.74% permanent increase in annual

consumption.[1] To understand why GJ find such small welfare gains, we begin by outlining their model. Consumers maximize the infinite sum of their discounted utility from consumption as follows:

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

subject to:

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

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

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

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

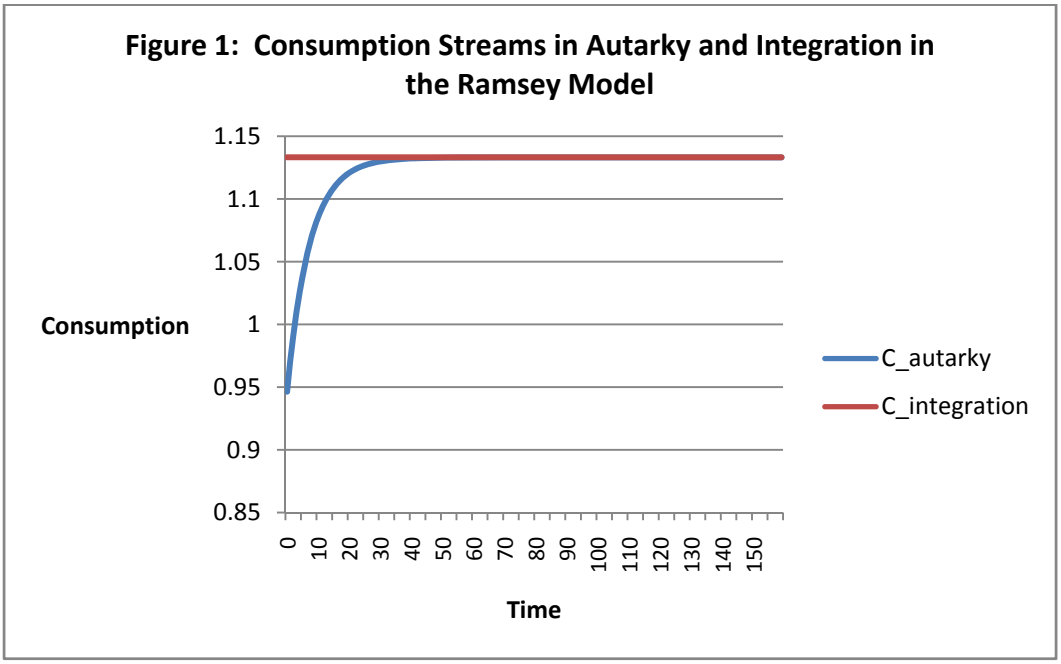
β, n and c are the discount factor, population, and per-capita consumption, respectively. Additionally, GJ assume that the domestic interest rate converges to a long run interest rate R^*, which is the same as the world interest rate by assumption.

$$\lim_{t \to +\infty} R_t = R^* = R_w^* \qquad (5)$$

The assumption made in (5) has significant implications for the impact of financial 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 $\tilde{c}_w^*$ (Figure 1).

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, financial liberalization serves to expedite an economy's movement towards its own (world) steady state (Figure 1).

[1] This welfare gain is dwarfed compared to policy changes that affect domestic factor productivity. In order to illustrate this point, GJ present a model with human capital accumulation in a "Macro-Mincer" framework and introduce distortions to the process of physical and human capital accumulation. Policies that improve the quality of education or remove distortions from the economy are found to have a profoundly greater welfare benefit than policies that liberalize the capital account.



3. Are Transitional Growth Effects Economically Meaningful?

In looking at transitional short-term effects an obvious question is of course whether these effects are economically meaningful. In other words, what is the magnitude of the welfare gains from financial liberalization?

3.1 The Magnitude of Welfare Gains in the Infinite Horizon

GJ report the gains from liberalization in terms of a Hicksian equivalent variation, μ, which is the percentage increase in 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, $U = \sum_{t=0}^{\infty}(\beta n)^t \log\,(g^t \tilde{c}_t)$. 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 mu 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:

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

Which is derived in the following manner :

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

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

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

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

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

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

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

Using the parameters in Table 1, GJ report average population weighted μ equal to 1.74%. The average initial population weighted capital-output ratio[2] is 1.4 for the 82 non-OECD countries in their sample.

Table 1

$\boldsymbol{\beta}$	$\boldsymbol{\alpha}$	$\boldsymbol{\delta}$	$\boldsymbol{g}$	$\boldsymbol{n}$	$\boldsymbol{\mu}$
0.96	0.3	0.06	1.012	0.0074	1.74%

Following GJ's interpretation of financial liberalization, and using their parameter values, we calibrate the consumption paths of the autarkic and integrated economies in order to calculate μ. Since it is assumed that the initial capital-output ratio is 1.4, the autarkic economy will climb from the resulting initial level of capital, 1.62, to the steady state level of capital, 3.97. We calculate the path of autarkic

[2] This is the population-weighted average capital–output ratio equal to 1·40 for 82 non-OECD countries in the Penn World Tables in 1995.

capital by linearizing the system of equations (2), (3), and (5) (Hoxha et al, 2009). This leads to the following optimal path for capital:

$$\tilde{k}_{t+1} = (1-\rho)\tilde{k}^* + \rho\tilde{k}_t$$

where:

$$\rho = \frac{\phi}{2} - \left(\frac{\phi^2}{4} - \frac{1}{\beta}\right)^2$$

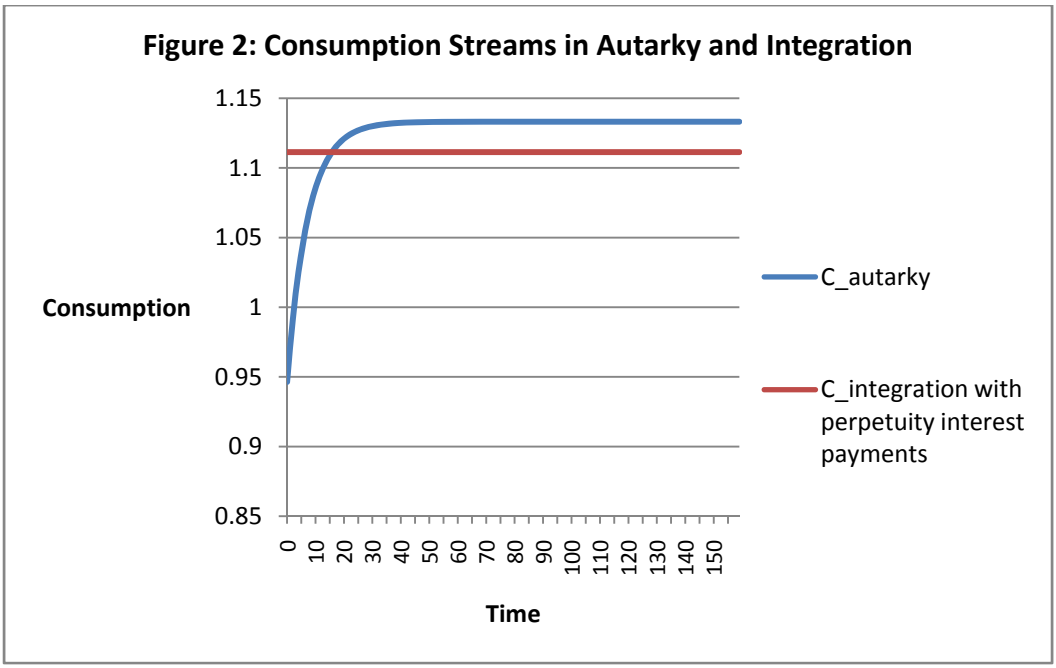
and:

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

Using this path for the optimal capital stock in an autarkic economy, we can find the corresponding optimal consumption path using the budget constraint (2). Along this path, consumption will also increase from its initial value of 0.87 to its steady state value of 1.2. This consumption path is used in calculating U_{aut}.

In the case of financial 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, 1.2, from the initial period onward; this path is used to calculate U_{int}. The population weighted average value of μ that GJ get as a result of these calculations for the 102 countries in their sample is 1.74%. This means that in a neoclassical economy with no frictions, capital scarcity keeps consumption in the autarkic economy from being, on average, 1.74% higher forever.

Figure 2 presents a graphical representation of the results. Note that the consumption stream under integration is lower than in Figure 1. Gourinchas and Jeanne (2006) 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.



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 financial 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 GJ (2006) formulation, after the autarkic economy converges to the steady state, its consumption stream is the same as that of the integrated economy. Let t* be the point in time when convergence occurs, we can represent welfare in autarky and integration as:

$$U_{aut} = \sum_{t=0}^{t*} (\beta n)^t \log\left(g^t \tilde{c}_t^{aut}\right) + \sum_{t=t*+1}^{\infty} (\beta n)^t \log\left(g^t \tilde{c}_t^{*}\right)$$

and

$$U_{int} = \sum_{t=0}^{t*}(\beta n)^t \log\,(g^t \tilde{c}_t^{\,int}) + \sum_{t=t*+1}^{\infty}(\beta n)^t \log\,(g^t \tilde{c}_t^{\,*}).$$

Substituting these values into (6), we get the following expression for μ:

$$\mu = exp\left[(1-\beta n)\left(\sum_{t=0}^{t*}(\beta n)^t \log\,(g^t \tilde{c}_t^{\,int}) - \sum_{t=0}^{t*}(\beta n)^t \log\,(g^t \tilde{c}_t^{\,aut})\right)\right] - 1 \qquad (7)$$

(7) shows that the difference in welfare between the integrated and autarkic economies springs from the differences in the autarkic and integrated consumption streams before integration. The difference in welfare 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 only 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 for an infinite stream is calculated using the welfare difference coming from a finite segment of the infinite stream. In addition, the farther out consumption is in the future, the more it is discounted.

In order to deal with the horizon issue, we can calculate 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 $t^* \leq T$[3] and denote the percentage change in consumption by μ_T. 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:

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

This leads to the following expression for μ_T:

$$\mu_T = exp\left[\left(\frac{1-\beta n}{1-(\beta n)^{T+1}}\right)(U_{int} - U_{aut})\right] - 1 \qquad (8)$$

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

which is derived as follows:

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

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

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

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

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

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

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

Notice that in equation (7),$(U_{int} - U_{aut}) = \sum_{t=0}^{t^*}(\beta n)^t \log\left(g^t \tilde{c}_t^{int}\right) - \sum_{t=0}^{t^*}(\beta n)^t \log\left(g^t \tilde{c}_t^{aut}\right)$ 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, $\left(\frac{1-\beta n}{1-(\beta n)^{T+1}}\right)$. Since $\beta n < 1$ we know that $(1-\beta n) < \left(\frac{1-\beta n}{1-(\beta n)^{T+1}}\right)$; 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 country, Angola.

Table 2: Welfare Gains from Financial Liberalization over Finite Horizons: Example Angola

Time horizon	μ_T
5	1.17%
10	1.52%
15	1.61%
20	1.58%
25	1.50%
30	1.41%
35	1.31%
40	1.22%
45	1.14%
50	1.06%
∞	0.19%

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. Take the GJ (2006) formulation for liberalization for example. We know that after convergence, the autarkic economy will enjoy the same level of consumption as the integrated economy. Thus, in evaluating the benefit from liberalization, we'd 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.

For Angola, the infinite horizon μ is merely 0.19% increase in annual consumption. In contrast, the five year finite horizon μ is six times higher at 1.17%. 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, the finite horizon calculation of μ measures this instant increase upon liberalization. It is clear that the shorter the horizon, the larger the welfare gain.

4. Robustness Checks

(i) Conditional Convergence

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. Since the Gourinchas and Jeanne (2006) framework calls for absolute convergence to a world steady state pinned down by the world

interest rate, we make two additional computations. We quantify the finite horizon welfare gains with the autarkic economies converging to the world interest rate plus some country risk premium. We also use stock market data to use country-specific earnings price ratios as a measure of the capitalization rate. To be done…

(ii) Alternate Financial Contracts

Accounting for the Financial Costs of Liberalization: Alternate Debt Contracts

A second factor that can affect the magnitude of the welfare gain from liberalization is the cost associated with liberalizing the capital account. Capital that flows into a newly liberalized economy is not costless. Whether this capital is in the form of debt or equity, interest or dividend repayments must be made. This will impact the domestic consumption under integration and thus, welfare. We examine alternative financial contracts in order to quantify the net benefits of financial liberalization. Gourinchas and Jeanne (2006) 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 akin to equity investments. We examine alternative debt contracts of varying horizons to quantify the costs of financial liberalization and their impact on finite horizon welfare gains in liberalizing economies.

a) Infinite horizon model in Obstfeld-Rogoff (1996)

In an infinite horizon problem, however, the transversality condition implies that:

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

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

$$\bar{C} = \frac{R-1}{R}\left[R * B_t + \sum_{t=0}^{\infty}\left(\frac{1}{R}\right)^{t}(\bar{Y} - \bar{I})\right]$$

We return to a benchmark economy with an autarkic capital-output ratio of 1.4[4] 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. The welfare estimates are below (Table 3).

[4] Note that this is the average population weighted autarky-level capital output ratio in GJ.

Table 3: Welfare Gains from Financial Liberalization over Finite Horizons: Benchmark Economy with Autarky Capital-Output Ratio=1.4

Time horizon	μ_T
5	13.67%
10	10.34%
15	8.02%
20	6.43%
25	5.30%
30	4.48%
35	3.85%
40	3.37%
45	2.98%
50	2.67%
∞	0.85%

b) We also 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 $Principal_0$ /T, and the corresponding amount of debt outstanding at the end of year t will be $Pricipal_t = Principal_0 (1-t/T)$, for $t < 50$ and zero thereafter. In addition to principal, the country must pay interest on the amount of its external debt outstanding, in the amount $r*Principal_t$, where r is the world interest rate. The results are presented in Table 4 below.

Table 4: Welfare Gains from Financial Liberalization: 50 Year Debt Contract, Benchmark Economy, Autarky Capital-Output Ratio= 1.4

Time horizon	μ_T
5	10.3%
10	7.56%
15	5.58%
20	4.69%
25	3.88%
30	3.31%
35	2.97%
40	2.61%
45	2.4%
50	2.25%

(iii) Initiating the Autarkic Economy in 1960 rather than 1995 (GJ formulation). To be done…

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 financial 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 financial 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 financial 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 financial liberalization.

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