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TRANSFER PROGRAMS AND CONSUMPTION UNDER ALTERNATIVE INSURANCE SCHEMES AND LIQUIDITY CONSTRAINTS

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Abstract

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JELit Classification Codes: F4, F35, D9

Keywords: Transfers, insurance, liquidity constraint, intertemporal substitution, risk aversion.

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Abstract

We consider a dynamic allocation problem under alternative insurance and capital market regimes and proper risk aversion separate from intertemporal substitution. We apply the model to study the effect of one-size-fits-all transfers. We find that one-size-fits-all transfers can have different and diametrically opposed qualitative and quantitative effects on consumption, investment, expected growth of output and consumption and the fair price of insurance of the risky technology. The differences depend upon the regime of insurance to the risky technology, the regime of capital markets and the proper separate measures of risk aversion and intertemporal substitution.

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I. INTRODUCTION

The European Economic Community (EU) has been very active in the last 25 years promoting economic policies and interventions designed to transfer resources across member nations. Such policies are designed, implemented, and evaluated by the European Commission in Brussels.¹ The general rationale for these policies has been that large disparity in income per capita across countries and regions exists in Europe. In economic and policy circles throughout Europe, it is widely believed that pure market-driven mechanisms fail to close the gap in income disparities and some form of centralized policy intervention must be implemented to alleviate this problem. Alternatively, in the United States, transfer mechanisms are mostly endogenously determined by the federal fiscal system and market forces. Usually, whenever there is a recession in a region or state of the US, there is an expansion in another state or region. Tax revenues are higher in the expanding region allowing the federal government to transfer resources to the contracting region through federal unemployment benefits and other transfers. Authors such as Sala-i-Martin and Sachs (1992) have documented these mechanisms providing lessons for the EU. But, the EU has taken an interventionist approach to the problem by setting several transfer policies through structural funds programs.²

Recent economic evaluations of these economic policy interventions have revealed little success in closing the gap of income disparities in the EU. Boldrin and Canova (2001) show that income disparities in the EU remain basically unchanged despite the relative large transfer programs

¹ See the recent studies of Boldrin and Canova (2001) and Puga (2000) for descriptions of these policies and programs.

² Relative to the EU, the US has a much smaller disparity in per capita income levels. For example, Boldrin and Canova (2001) report that the ratio between the income per capita of the richest and poorest states in the US is less than 2 while in the EU it is more than 5. In another important dimension, the US presents much higher mobility of labor than the EU. The emphasis of this paper is on a transfer of initial endowment in income. Yet, other income support programs to specific sectors such as farmers and labor have existed throughout the EU. In the case of the E.U., one of the main areas of focus has been public infrastructure. Transfers are setup for specific public investments in certain regions of countries identified as having income per capita well below the average of the EU. One of the key aspects of the programs is that a recipient nation must co-finance the specific infrastructure project both with public and private sector funds. Economists understand this "additionality" principle as a simple mechanism, designed to provide incentives for the best use of the resources in the economy. The EU is using such mechanisms to even screen potential new members from Eastern Europe in a new 2001-2006 program. The main recipient nations from the 1990s programs have been Greece, Ireland, Portugal and Spain. The recipients of the new wave of transfers include Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia; see e.g. Chatterjee, Sakoulis and Turnovsky (2000). There are of course political reasons behind the transfer schemes as well. For example, the 1990s program is perceived as a premium for the poorest regions for the admission of Austria, Finland and Sweden in the union.

of the last 10 years. Countries and regions seem to be growing at roughly equal and constant rates, with the notable exception of Ireland that has been growing much faster than average.

This paper aims to analyze the problem of one-size-fits-all transfers roughly inspired by the case of the EU. We construct a simple dynamic model of saving and investment. There are two possible forms of saving. One is in the capital market and the other is in a risky technology that provides a much higher average return. The probability of success of the investment in the risky technology, or the actuarially fair price of insurance of the risky technology is assumed to be increasing at decreasing rates in the level of investment, so that higher investment levels make insurance more costly, e.g. Gertler and Rogoff (1990). The idea of co-financing is implicit by assuming a marginal transfer of date-1 endowment to an individual, region or country. We consider several alternative economic scenarios. First, we examine a case where there is full insurance for the risky technology so that an investment in the risky technology yields a sure average return. This regards the possibility that the transfer is given to the recipient nation and there is full insurance for the risky investment available (possibly paid by the donating country at fair prices). We assume that the fair price of insurance is increasing in the level of investment in the risky technology so that scale has an effect on the price of insurance. Alternatively, we consider a case where there is no full insurance available and the individual (region or country) bears all the risk of the investment in the risky technology. We consider two regimes regarding capital markets: one where saving in the capital market is unrestricted at the given risk-free return, or perfect capital markets; and an alternative where the individual (region or country) faces a date-1 liquidity constraint and does not have access to the capital market in date-1. We also consider alternative attitudes towards risk and intertemporal substitution in a general framework of dynamic preferences, which separate intertemporal substitution from risk aversion, e.g. Epstein and Zin (1989, 1991), Weil (1989, 1991).³ This allows us to consider alternative preferences towards late versus early resolution of risk and its effect on the endogenous variables in the presence of transfers.

Our main result is that one-size-fits-all transfers can have very different impacts in individuals (countries or regions) depending upon the specific regime regarding insurance for the risky technology, capital markets and attitudes towards risk and intertemporal substitution in preferences. We show that if transfers are of the one-size-fits-all type, the results of Boldrin and Canova (2001)

³ Obstfeld (1994) present a recent application of this class of preferences in closed economies, and Giuliano and Turnovsky (2003) present an application in small open economies. See also Bianconi (2003) for a survey of models in discrete and continuous time.

are not surprising, and the growth effects of transfers can vary both qualitatively and quantitatively across different regimes. A literature in international trade theory and intertemporal dynamics has also provided frameworks where transfers, either temporary or permanent, can have permanent effects on allocation of resources. Examples in the international trade and intertemporal dynamics areas are Turenen-Red and Woodland (1988), Haaparanta (1988) and Galor and Polemarchakis (1987). Bhagwati (1968) is a seminal contribution on the issue of international transfers and the potential adverse terms of trade effects ultimately leading to loss of welfare in the recipient nation. Recently, Chatterjee, Sakoulis and Turnovsky (2000) provide an analysis where a transfer in productive government spending can have positive growth effects on the economy. The novelty of this paper is to consider transfer programs in a simple two-period dynamic framework with a class of preferences that disentangle risk aversion from intertemporal substitution and the possibility of full insurance for the risky technology. Here, we claim that transfer programs that treat a set of recipient countries or regions or individuals as homogeneous can result in very different effects of the transfer on growth of output, consumption, and the allocation of resources. We show that it depends upon the regime of insurance for the risky technology, the regime of capital markets, and attitudes towards intertemporal substitution and risk aversion in a proper framework that separates the two. Thus, our contribution is more in the spirit of an early contribution of Eaton and Gersowitz (1989) who study international capital transfers and their price, depending on risk factors associated with the recipient nation.⁴ When the transfer program is provided along with full insurance for the risky investment, growth in consumption and output is not enhanced. When the transfer program is provided without full insurance, the growth effects are positive only in special cases: (i) when $CRRRA = 1/EIS$ and there are perfect capital markets; or (ii) when $CRRRA = 1/EIS \leq 2$ and there are liquidity constraints. When $CRRRA \neq 1/EIS$, preferences towards early (late) versus late (early) resolution of risk have an important effect on the allocation of resources, and can render the effects of transfers qualitatively and quantitatively opposed to the case when $CRRRA = 1/EIS$.

In section II we present the basic model. Section III solves for the equilibrium and computes the qualitative effects of transfers in the alternative regimes. Section IV provides a quantitative evaluation of the transfers under the alternative regimes and a sensitivity analysis regarding the parameters of preferences. Section V concludes.

⁴ Another important literature builds on the seminal contributions of Persson and Tabellini (1996a,b). They follow a political-economy approach focusing on voting schemes associated with the transfers.

II. BASIC MODEL

There are two periods and a single composite commodity is produced. A representative individual (region or country) can use the commodity to consume, to save in the capital market or to invest in a risky technology. In the first period, say date-1, the individual receives an exogenous endowment y , engages in consumption, c_1 , engages in investment in the risky technology, k , or saves in the capital market, $s = y - c_1 - k$ at the given market interest factor $R > 1$, as in a small (open) economy.

In the second period, say date-2, individuals can consume c_2 , and receive proceeds from the risky investment as follows: one unit of investment in the risky technology in date-1 yields y_2 units of the consumption good where y_2 is a random variable with probability distribution

$$y_2 = \begin{cases} z \text{ with probability } \pi(k) \\ z_0 \text{ with probability } 1 - \pi(k) \end{cases} \quad (1)$$

for $z > z_0$ and the probability function $\pi(k) \geq 0$, is well-defined, with $\pi' > 0$, $\pi'' < 0$, or π is strictly increasing and strictly concave in date-1 investment k . The probability function π is assumed to be increasing in the level of investment in the risky technology capturing scale effects in the technology. Also, π will reflect the actuarially fair price of insurance for the risky investment, so that the larger the level of investment the larger the insurance costs; see e.g. Gertler and Rogoff (1990) for similar specifications. The individual intertemporal budget constraint is given by

$$c_1 + (c_2/R) + k \leq y + (y_2/R) \quad (2)$$

or the present value of consumption plus investment expenditure cannot exceed the present value of endowment plus proceeds from risky investment. In case of imperfect capital markets, the individual faces a date-1 liquidity constraint given by

$$c_1 + k = y \Rightarrow s = 0 \quad (3)$$

which prevents the individual to borrow against future random income. Utility takes the special isoelastic form

$$U(c_1, E[c_2]) = \{c_1^\rho + \beta(E[c_2^\gamma])^{\rho/\gamma}\}^{1/\rho} \quad (4)$$

where $1 - \gamma \geq 0$, $\gamma \neq 0$, is the coefficient of relative risk aversion (*CRR*A), $(1/1 - \rho) \geq 0$, $\rho \neq 0$, is the elasticity of intertemporal substitution (*EIS*), and $\beta \in [0, 1)$ is the subjective discount factor. U is the so-called aggregator function that separates *EIS* from *CRR*A as in Epstein and Zin (1989, 1991), Weil (1989, 1990). When $\gamma = \rho$, or *CRR*A = *EIS*, we obtain the usual VNM expected utility where risk aversion is inversely related to intertemporal substitution. In general, we define the expected growth of consumption and of output as

$$g_c \equiv E[c_2/c_1] - 1, \quad (5a)$$

$$g_y \equiv E[y_2/\underline{y}] - 1. \quad (5b)$$

We study the general problem of the individual (or region or country) receiving a transfer in date-1, $\partial \underline{y} > 0$, and its effect on consumption, investment in the risky technology and saving as a function of *EIS* and *CRRRA*. The general problem is studied with two regimes of insurance regarding the risky technology in expression (1), full insurance at actuarially fair prices and no insurance; and two regimes of capital markets, perfect capital markets where (3) does not hold and imperfect capital markets where (3) holds.

III. EQUILIBRIUM UNDER ALTERNATIVE MARKET REGIMES

We examine the equilibrium under alternative market regimes regarding the availability of capital markets for borrowing and lending and the availability of insurance for the risky technology.

(i) Full Insurance with Fair Prices and Perfect Capital Markets

The first case examined is full insurance with actuarially fair prices and perfect capital markets. Since there is full insurance available for the risky technology, the date-2 consumption is non-stochastic. The utility becomes the usual CES and risk aversion does not matter in this case. The individual problem becomes

$$\text{Max}_{\{c_1, c_2, k\}} U(c_1, c_2) = \{c_1^\rho + \beta c_2^\rho\}^{1/\rho} \quad (6)$$

$$\text{subject to } c_1 + (c_2/R) + k \leq \underline{y} + (\{\pi(k)z + [1-\pi(k)]z_0\}/R)$$

with $\{\underline{y} \geq 0, R \geq 0, 0 < z < z_0, \rho \leq 1\}$ given. The necessary first order conditions for this problem yield optimality conditions

$$c_2 / c_1 = (\beta R)^{1/(1-\rho)} \quad (7a)$$

$$\pi'(k)(z - z_0) = R \quad (7b)$$

$$c_2 = R(\underline{y} - c_1 - k) + \pi(k)z + [1-\pi(k)]z_0 \quad (7c)$$

giving solutions for the demands $\{c_1, c_2, k\}$ as a function of the parameters $\{\underline{y} \geq 0, R \geq 0, 0 < z < z_0, \rho \leq 1\}$. The effects of a transfer as a marginal increase in \underline{y} in this case are given by

$$\partial c_1 / \partial \underline{y} = \beta^{1/(\rho-1)} R^{\rho/(\rho-1)} / (1 + \beta^{1/(\rho-1)} R^{\rho/(\rho-1)}) > 0 \quad (< 1) \quad (8a)$$

$$\partial c_2 / \partial \underline{y} = R / (1 + \beta^{1/(\rho-1)} R^{\rho/(\rho-1)}) > 0 \quad (8b)$$

$$\partial k / \partial \underline{y} = 0 \quad (8c)$$

Consumption in both periods increase and investment in the technology is unchanged. The effect on saving is

$$\partial s / \partial \underline{y} = 1 / (1 + \beta^{1/(\rho-1)} R^{\rho/(\rho-1)}) > 0 (< 1) \quad (8d)$$

and saving in capital markets increases as well. The price of insurance is

$$\partial \pi(k) / \partial \underline{y} = 0 \quad (8e)$$

unchanged since investment in the technology is unchanged. The effects on expected growth are

$$\partial g_c / \partial \underline{y} = 0, \quad (8f)$$

$$\partial g_y / \partial \underline{y} = - \{ \pi(k) z + [1 - \pi(k)] z_0 \} / \underline{y}^2 < 0. \quad (8g)$$

The growth of consumption is unchanged, but the growth of output decreases since second period output is unchanged and no additional investment in the technology occurs. Figure 1 presents the equilibrium in growth of consumption and investment space, $\{g_c, k\}$, from equations (7a)-(7b) and the potential effects of a positive transfer, $\partial \underline{y} > 0$. In this case, the equilibrium is at point A, labeled No Liquidity Constraint, and the effect of the transfer is null since $\{g_c, k\}$ are determined independently of each other and independently of \underline{y} , i.e. a positive transfer affects date-1 and date-2 consumption proportionally.

(ii) Full Insurance with Fair Prices and Liquidity Constraint

Consider the same problem (6) but with the additional liquidity constraint (3). In this case saving in capital markets is null, and (average) returns are received when investment is made in the technology. The solution of the problem (6) with the additional constraint (3) is given by

$$\beta \pi'(k) (z - z_0) = (c_2 / c_1)^{(1-\rho)} \quad (9a)$$

$$c_2 = \pi(k) z + [1 - \pi(k)] z_0 \quad (9b)$$

and (3), giving solutions for the demands $\{c_1, c_2, k\}$ as a function of the parameters $\{\underline{y} \geq 0, R \geq 0, 0 < z < z_0, \rho \leq 1\}$. The effects of a transfer as a marginal increase in \underline{y} in this case are given by

$$\begin{aligned} \partial c_1 / \partial \underline{y} = \{ (z - z_0) [\beta \pi''(k) c_1 - (1-\rho) g_c^{-\rho} \pi'(k)] \} \\ / \{ (z - z_0) [\beta \pi''(k) c_1 - (1-\rho) g_c^{-\rho} \pi'(k)] - (1-\rho) g_c^{-\rho-1} \} > 0 \end{aligned} \quad (10a)$$

$$\partial c_2 / \partial \underline{y} = - \pi'(k) (z - z_0) (1-\rho) g_c^{-\rho-1} / \{ (z - z_0) [\beta \pi''(k) c_1 - (1-\rho) g_c^{-\rho} \pi'(k)] - (1-\rho) g_c^{-\rho-1} \} > 0 \quad (10b)$$

$$\partial k / \partial \underline{y} = - (1-\rho) g_c^{-\rho-1} / \{ (z - z_0) [\beta \pi''(k) c_1 - (1-\rho) g_c^{-\rho} \pi'(k)] - (1-\rho) g_c^{-\rho-1} \} > 0 \quad (10c)$$

Consumption increases in the first and second periods while investment in the technology also increases. The saving effect is

$$\partial s / \partial \underline{y} = 0 \quad (10d)$$

and saving in capital markets is unchanged. The price of insurance effect is

$$\partial \pi(k) / \partial \underline{y} = - \pi'(k)(1-\rho) g_c^{-\rho-1} / \{(z-z_0)[\beta \pi''(k) c_1 - (1-\rho) g_c^{-\rho} \pi'(k)] - (1-\rho) g_c^{-\rho-1}\} > 0 \quad (10e)$$

and the price of insurance increases because there is more investment in the technology. The growth effects are

$$\partial g_c / \partial \underline{y} = (1-\rho)^{-1} [\beta \pi'(k)(z-z_0)]^{\rho/(1-\rho)} \beta \pi''(k)(z-z_0) (\partial k / \partial \underline{y}) < 0 \quad (10f)$$

$$\partial g_y / \partial \underline{y} = [\{\pi'(k)(z-z_0) (\partial k / \partial \underline{y})\} - \{\pi(k) z + [1-\pi(k)] z_0\}] / \underline{y}^2 \lesseqgtr 0. \quad (10g)$$

The growth of consumption decreases and the growth of output is ambiguous since there is more investment in the technology but also more first period endowment. Figure 1 presents the equilibrium in growth of consumption and investment space, $\{g_c, k\}$, from equations (9a)-(9b)-(3) and the effects of a positive transfer, $\partial \underline{y} > 0$. In this case, the initial equilibrium is at point B, labeled Liquidity Constraint. The downward sloping function reflects a negative relationship between $\{g_c, k\}$ from the investment condition, (9a) as

$$\partial g_c / \partial k |_{LC,k} = \beta \pi''(k) / (1-\rho) g_c^{-\rho} < 0$$

because from (9a), the (expected) growth in consumption is basically determined by the marginal effect of investment on the fair price of insurance, $\pi'(k)$, assumed to be decreasing in k meaning that the higher the level of investment, the fair price of insurance increases at decreasing rates. The upward sloping function reflects a positive relationship between $\{g_c, k\}$ from the date-2 consumption, (9b), and the liquidity constraint (3) as

$$\partial g_c / \partial k |_{LC,g_c} = [\pi'(k)(z-z_0)/c_1] + [\{\pi(k) z + [1-\pi(k)] z_0\}/c_1^2] > 0$$

because, in this case, from (9b), the (expected) growth in consumption is basically determined by the impact effect of investment on the fair price of insurance, $\pi(k)$, assumed to be increasing in k meaning that the higher the level of investment, the fair price of insurance increases. The effect of a positive transfer, $\partial \underline{y} > 0$, is to move the equilibrium to point C, where growth of consumption decreases and investment in the risky technology increases. Given the liquidity constraint, an increase in \underline{y} creates excess demand for date-1 consumption and investment, thus $\{c_1, k\}$ both increase at a first order rate. The higher investment increases date-2 consumption because the return is the sure average, but the initial increase in date-1 consumption is higher because date-2 consumption increases at a second order rate. The growth in consumption decreases and investment increases to the final equilibrium at point C. It is worth noting that, given the strict concavity of the probability function in investment, the case of perfect capital markets at point A presents higher investment and lower growth of consumption relative the liquidity constraint case of points B and C. A positive

transfer lowers the marginal value of the liquidity constraint bringing the equilibrium closer to point A, from points B to C.

(iii) No Full Insurance Available and Perfect Capital Markets

In this case there is no full insurance with fair prices and the individual must face the risk of the technology. Hence risk aversion matters and utility is given in expression (4). There are perfect capital markets for saving. The individual problem becomes

$$\text{Max}_{\{c_1, c_2, k\}} U(c_1, E[c_2]) = \{c_1^\rho + \beta(E[c_2^\gamma])^{\rho/\gamma}\}^{1/\rho} = U(c_1, c_2, k) \quad (11)$$

$$\text{subject to} \quad c_1 + (c_2/R) + k \leq \underline{y} + [y_2(z')/R], \quad z' = \{z, z_0\}$$

with $\{\underline{y} \geq 0, R \geq 0, \text{probability distribution of } y_2(z), \rho \leq 1, \gamma \leq 1\}$ given. The necessary first order conditions for this problem yield optimality conditions

$$U_1(c_1, c_2, k) - R U_2(c_1, c_2, k) = 0$$

$$\Rightarrow c_1^{(\rho-1)} = \beta R [\pi(k) c_2(z)^\gamma - (1-\pi(k)) c_2(z_0)^\gamma]^{(\rho/\gamma)-1} [\pi(k) c_2(z)^{\gamma-1} - (1-\pi(k)) c_2(z_0)^{\gamma-1}] \quad (12a)$$

$$U_1(c_1, c_2, k) - U_3(c_1, c_2, k) = 0$$

$$\Rightarrow c_1^{(\rho-1)} = (\beta/\gamma) [\pi(k) c_2(z)^\gamma - (1-\pi(k)) c_2(z_0)^\gamma]^{(\rho/\gamma)-1} \{ \pi'(k) [c_2(z)^\gamma - c_2(z_0)^\gamma] \} \quad (12b)$$

$$c_2(z) = R(\underline{y} - c_1 - k) + z \quad (12c)$$

$$c_2(z_0) = R(\underline{y} - c_1 - k) + z_0 \quad (12d)$$

where $U_1(c_1, c_2, k) \equiv \partial U / \partial c_1$, etc. giving solutions for the demands $\{c_1, c_2(z), c_2(z_0), k\}$ as a function of the parameters $\{\underline{y} \geq 0, R \geq 0, \text{probability distribution of } y_2(z), \rho \leq 1, \gamma \leq 1\}$. The effects of a transfer as a marginal increase in \underline{y} in this case are given by

$$\partial c_1 / \partial \underline{y} = (a_{22} b_1 - a_{12} b_2) / (a_{11} a_{22} - a_{12} a_{21}) \quad (13a)$$

$$\partial c_2(z) / \partial \underline{y} = \partial c_2(z_0) / \partial \underline{y} = R \{1 - [(a_{22} b_1 - a_{12} b_2) + (a_{22} b_1 - a_{12} b_2) / (a_{11} a_{22} - a_{12} a_{21})]\} \quad (13b)$$

$$\partial k / \partial \underline{y} = (a_{11} b_2 - a_{21} b_1) / (a_{11} a_{22} - a_{12} a_{21}) \quad (13c)$$

where the coefficients are $a_{11} \equiv U_{11} - U_{13}$; $a_{12} \equiv U_{13} - U_{33} - U_{12} + U_{23}$; $a_{21} \equiv U_{11} - 2RU_{12} + RU_{12} + R^2 U_{22}$; $a_{22} \equiv U_{13} - RU_{23} - RU_{12} + R^2 U_{22}$; $b_1 \equiv U_{23} - U_{12}$; $b_2 \equiv R(RU_{22} - U_{12})$; and $U_{11}(c_1, c_2, k) = \partial^2 U / \partial c_1^2$, etc.

We cannot exactly sign the effects in this case. For saving we have

$$\partial s / \partial \underline{y} = \{1 - [(a_{22} b_1 - a_{12} b_2) + (a_{22} b_1 - a_{12} b_2) / (a_{11} a_{22} - a_{12} a_{21})]\} \quad (13d)$$

and the price of insurance effect is,

$$\partial \pi(k) / \partial \underline{y} = \pi'(k) (a_{11} b_2 - a_{21} b_1) / (a_{11} a_{22} - a_{12} a_{21}). \quad (13e)$$

The expected growth effects are

$$\begin{aligned} \partial g_c / \partial \underline{y} = & ([\{ [\pi'(k) \{ c_2(z) - c_2(z_0) \} (\partial k / \partial \underline{y})] + (\partial c_2(z) / \partial \underline{y}) \}] c_1 \\ & - \{ [\pi(k) c_2(z) - (1-\pi(k)) c_2(z_0)] (\partial c_1 / \partial \underline{y}) \}] / c_1^2 \end{aligned} \quad (13f)$$

$$\partial g_y / \partial \underline{y} = [\pi'(k)(z - z_0)] (\partial k / \partial \underline{y}) - [\pi(k) z - (1-\pi(k)) z_0] / \underline{y}^2. \quad (13g)$$

The qualitative effects in this case are ambiguous and we shall use simple numerical simulations below to understand the effects of the transfer on the endogenous variables as a function of intertemporal substitution and risk aversion.

(iv) No Full Insurance Available and Liquidity Constraint

Finally, consider the same problem (11) but with the additional liquidity constraint (3). In this case saving in capital markets is null, and returns are possible when investment is made in the risky technology. The solution of the problem (11) with the additional constraint (3) is given by

$$c_1^{(\rho-1)} = (\beta/\gamma) [\pi(k) c_2(z)^\gamma - (1-\pi(k)) c_2(z_0)^\gamma]^{(\rho/\gamma)-1} \{ \pi'(k) [c_2(z)^\gamma - c_2(z_0)^\gamma] \} \quad (14a)$$

$$c_2(z) = z \quad (14b)$$

$$c_2(z_0) = z_0 \quad (14c)$$

and (3), giving solutions for the demands $\{c_1, c_2(z), c_2(z_0), k\}$ as a function of the parameters $\{\underline{y} \geq 0, R \geq 0, \text{probability distribution of } y_2(z), \rho \leq 1, \gamma \leq 1\}$. The effects of a transfer as a marginal increase in \underline{y} in this case are given by

$$\begin{aligned} \partial c_1 / \partial \underline{y} = & 1 - \{ (1-\rho)(\underline{y} - k)^{\rho-2} / [(1-\rho)(\underline{y} - k)^{\rho-2} - (\beta/\gamma) [\pi(k) z^\gamma - (1-\pi(k)) z_0^\gamma]^{(\rho/\gamma)-1} \\ & \times \{ \pi''(k) [z^\gamma - z_0^\gamma] \} - (\beta/\gamma)[(\rho/\gamma) - 1] [\pi(k) z^\gamma - (1-\pi(k)) z_0^\gamma]^{(\rho/\gamma)-2} \{ \pi'(k) [z^\gamma - z_0^\gamma] \}^2] \} \end{aligned} \quad (15a)$$

$$\partial c_2(z) / \partial \underline{y} = \partial c_2(z_0) / \partial \underline{y} = 0 \quad (15b)$$

$$\begin{aligned} \partial k / \partial \underline{y} = & (1-\rho)(\underline{y} - k)^{\rho-2} / [(1-\rho)(\underline{y} - k)^{\rho-2} - (\beta/\gamma) [\pi(k) z^\gamma - (1-\pi(k)) z_0^\gamma]^{(\rho/\gamma)-1} \\ & \times \{ \pi''(k) [z^\gamma - z_0^\gamma] \} - (\beta/\gamma)[(\rho/\gamma) - 1] [\pi(k) z^\gamma - (1-\pi(k)) z_0^\gamma]^{(\rho/\gamma)-2} \{ \pi'(k) [z^\gamma - z_0^\gamma] \}^2] \end{aligned} \quad (15c)$$

Again in this case, the signs of the effects are ambiguous except for the date-2 consumption which does not change since it is a contingent claim on the risky technology. The saving effect is null as well

$$\partial s / \partial \underline{y} = 0, \quad (15d)$$

and the price of insurance effect is ambiguous

$$\partial \pi(k) / \partial \underline{y} = \pi'(k) (\partial k / \partial \underline{y}). \quad (15e)$$

The expected growth effects are

$$\partial g_c / \partial \underline{y} = \{ \pi'(k)(z - z_0) + [\pi(k)z - (1-\pi(k))z_0] \} (\partial k / \partial \underline{y}) - [\pi(k)z - (1-\pi(k))z_0] / c_1^2 \quad (15f)$$

$$\partial g_y / \partial \underline{y} = [\pi'(k)(z - z_0)] (\partial k / \partial \underline{y}) - [\pi(k)z - (1-\pi(k))z_0] / \underline{y}^2. \quad (15g)$$

As in case (iii), given that the effects are not easily signed analytically, we resort below to some simple numerical evaluations of the alternative regimes.

IV. QUANTITATIVE EVALUATION AND THE ROLE OF RISK AVERSION AND INTERTEMPORAL SUBSTITUTION

We evaluate quantitatively the effects of the transfer programs. The specific form of the probability function is assumed to be Cobb-Douglas with a trend, or

$$\pi(k) = p + h k^\alpha, \quad \alpha \in (0,1), \{ p, h > 0: 0 \leq p + h k^\alpha \leq 1, \text{ all } k \} \quad (16)$$

where parameters $\{p, h, \alpha\}$ are chosen so that the probability function is well defined. The quantitative assessment starts by first assuming a benchmark for the set of parameters $\{\beta, \alpha, z, z_0, p, h, R, \underline{y}\}$. We then evaluate the equilibrium under the benchmark $\{\beta, \alpha, z, z_0, p, h, R, \underline{y}\}$, for several configurations of the preference parameters $\{\rho, \gamma\}$ regarding intertemporal substitution and risk aversion. In each configuration of the preference parameters and for each regime examined in section III, we evaluate the elasticities of endogenous variables given an exogenous transfer, where in the case of expected growth rates and probability of success we evaluate semi-elasticities. The elasticity of investment is $\xi_{ky} \equiv (\partial k / \partial \underline{y})(\underline{y}/k)$ so that a 1% transfer increases investment by ξ_{ky} %; of date-1 consumption it is $\xi_{c_1y} \equiv (\partial c_1 / \partial \underline{y})(\underline{y}/c_1)$; etc. The semi-elasticity of expected growth of consumption is given by $\xi_{gcy} \equiv (\partial g_c / \partial \underline{y})(\underline{y})$, etc. Computation of quantitative elasticities allows us to properly compare results across regimes and parameters of risk aversion and intertemporal substitution.

Hence, our thought experiment is to use different values of intertemporal substitution and risk aversion to capture the extent to which potential differences across countries or regions or individuals, in terms of fundamental parameters of preferences, can affect the qualitative and quantitative outcomes of transfer programs. In addition, by considering the different regimes regarding insurance and capital markets from section III, we can capture the extent to which potential differences across nations regarding insurance and capital market structure affect the quantitative outcome of the transfer program. The benchmark set of parameter values is $\{\beta=0.995, \alpha=0.1, z=2, z_0=0.25, p=0.0001, h=0.65, R=1.025, \underline{y}=1\}$. This implies a low rate of time preference of 0.5%, well less than the given market interest rate of 2.5%. The benchmark is one where individuals (nations or regions) are patient relative to market opportunities to transfer consumption. The parameters for the

probability function reflect a plausible elasticity with respect to investment of 0.1 , and yield a well-defined probability function. The initial endowment is set at unity and the range of outputs from the risky technology is $\{2, 0.25\}$. The range of values of $\{\rho, \gamma\}$ considered is $\{\rho = -1, -2, -4, -9; \gamma = -1, -2, -4, -9\}$. This yields a range of values for EIS and $CRRA$ as $\{EIS = 1/2, 1/3, 1/5, 1/10; CRRA = 2, 3, 5, 10\}$. Those values are well known in the dynamic quantitative literature and have been recently discussed and used by Giuliano and Turnovsky (2003) in a different context.

Table 1 presents the results for the regime of full insurance in section III, and the cases of perfect capital markets (i) and liquidity constraint (ii). As mentioned, in this case risk aversion is irrelevant because there is no risk in the technology and we present the results for the alternative EIS . The results confirm the findings of Figure 1. Under perfect capital markets, all elasticities and price of insurance are insensitive to the EIS , except for the elasticity of capital market saving. The fair price of insurance is about $1/2$ indicating an average return on investment of about 14% well above the risk-free return on the capital market of 2.5% . However, the investment level is at bliss in (7b) and it remains unchanged. The lower the EIS , the lower (in absolute value) the elasticity of capital market saving because there is less willingness to engage in capital market activity. The effect of the variation in EIS is fully absorbed by capital market saving without any effect on other endogenous variables as one would expect under perfect capital markets. The case of liquidity constraint involves sensitivity of the elasticities across alternative EIS . At $EIS=1/2$, the elasticity of investment is $\xi_{ky}=1.426$, of date-1 consumption $\xi_{c1y}=0.971$, of date-2 consumption $\xi_{c2y}=0.109$, the semi-elasticities of growth of output, consumption and fair price of insurance are given respectively by $\xi^*_{gy} = -0.950$, $\xi^*_{gy} = -0.981$, $\xi^*_{\pi} = 0.066$, and the fair price of insurance is $\pi(k)=0.446$. As the EIS decreases, the elasticities of investment and date-2 consumption increase while the elasticity of date-1 consumption decreases. The fair price of insurance decreases as well as the semi-elasticities of growth of income and consumption in absolute value. Comparing the liquidity constraint case with the perfect capital market case, we find that the introduction of the liquidity constraint increases the elasticity of date-1 consumption but decreases the elasticity of date-2 consumption across the spectrum of all EIS , as one would expect under constraints on date-1 consumption. The fair price of insurance is lower under liquidity constraint because the level of investment is lower in that case, e.g. Figure 1.

Table 2 presents the cases for the regime without full insurance of the risky technology under alternative intertemporal substitution and risk aversion. Panel (a) refers to the elasticity of investment in the risky technology, ξ_{ky} . The shaded diagonal areas represent cases where $CRRA=1/EIS$, or the

simple expected utility framework of Von-Neumann and Morgenstern. The first important result is that in the columns for $EIS=1/2$, ξ_{ky} is initially positive for $CRR=1/EIS$, but it becomes negative and decreases as CRR increases, or $CRR > 1/EIS$. The reason is that when $CRR > 1/EIS$, the individual values more risk aversion than intertemporal substitution in utility and prefers early versus late resolution of risk, e.g. Kreps and Porteus (1978), Epstein and Zin (1991), Weil (1990). And thus, the higher the risk aversion, the more the individual avoids the risky technology. This effect is confirmed in panels (b), (c), (d) and (e) where the elasticities for date-1 and date-2 consumption and saving are first negative and become positive as CRR increases. The same effects can be observed in panels (f), (g), (h), (i) where the semi-elasticities of growth of output, consumption, and fair price of insurance are first positive for $CRR=1/EIS$, and become negative as $CRR > 1/EIS$, while the fair price of insurance decreases from 0.461 when $CRR = 1/EIS$ to 0.375 when $CRR > 1/EIS$. Next consider the cases where $CRR < 1/EIS$. In the rows for $CRR=2$, ξ_{ky} is positive for $CRR=1/EIS$, and decreases for $CRR < 1/EIS$. The pattern is analogous to the case $CRR > 1/EIS$, because investment in the risky technology k , is only one part of the total saving available for investment, the other part is invested in the risk-free capital market. In panel (e), the elasticity of saving is first negative, but it is increasing in $1/EIS$. Now, the individual values less risk aversion and more intertemporal substitution in utility and prefers late versus early resolution of risk. In panels (b), (c), and (d), we observe that the elasticities for date-1 and date-2 consumption and saving are first negative and become positive and mostly increasing as $1/EIS$ increases. In this case, there is preference for late resolution of risk and, given risk aversion, the saving in the risk-free market increases as $CRR < 1/EIS$.

We discuss next the specific magnitudes of the elasticities. In all panels, we note that under perfect capital markets, for $CRR=1/EIS$ increasing (that is moving along the diagonal shaded area), ξ_{ky} increases, ξ_{c1y} , ξ_{c2zy} , ξ_{c2z0y} , ξ_{sy} all increase in absolute value, and ξ_{gyy} , ξ_{gcy} , $\xi_{\pi y}$ also increase, while for the fair price of insurance, $\pi(k)$ decreases. As $CRR=1/EIS$ increases, the level of investment in the risky technology decreases, but it becomes more elastic when impacted by a transfer and this effect propagates to all other variables that depend on the second order marginal effects of the transfer. The only exception is the price of fair insurance that depends directly on the level of the investment in the risky technology and thus declines. Next, considering the cases of liquidity constraints binding, for $CRR=1/EIS$ increasing, ξ_{ky} decreases, ξ_{c2zy} , ξ_{c2z0y} , ξ_{sy} are all unchanged, and ξ_{gyy} , ξ_{gcy} , $\xi_{\pi y}$ all decrease, while $\pi(k)$ increases. In this case, the fair price of insurance is uniformly higher than under perfect capital markets. As $CRR=1/EIS$ increases, the level of investment in the risky technology increases

under liquidity constraints, but it becomes less elastic when impacted by a transfer. In this case, date-2 consumption and saving in the capital market are unchanged and the elasticity of date-1 consumption, ξ_{c1y} , is negative but, first increases and then decreases in absolute value (hump shaped). This is because the transfer is split between date-1 consumption and investment, and as the transfer impacts the level of investment upwards, there are less resources available for date-1 consumption (a substitution effect) which is counter to the positive (income) effect of the additional transfer on consumption. Thus, the hump shape in the elasticity of date-1 consumption, ξ_{c1y} , reflects the unbalance between those two forces. Identical effect is reflected for the semi-elasticity of expected growth of consumption in panel (e).

Regarding the regime of full insurance versus no full insurance, we note that when the transfer program is provided along with full insurance for the risky investment, the effect on the expected growth in consumption and output is not positive. With full insurance, the investment in the risky technology only increases when the liquidity constraint is binding for all plausible levels of intertemporal substitution, but the growth effect is always negative. In the absence of full insurance, the expected growth effect can be positive mostly when $CRR=1/EIS$ and we discuss it next.

Finally, we examine the qualitative aspects of the quantitative evaluation. Depending upon the values of intertemporal substitution and risk aversion, the regime regarding insurance of the risky technology and the regime regarding capital markets, Tables 1 and 2 show that the effects of a transfer to an individual, region or nation can be substantively different. In the case of no full insurance and perfect capital markets [Table 2, (iii)], a transfer has a positive effect on investment in the risky technology only when $CRR \leq 1/EIS$. However, it is only when $CRR=1/EIS$ that a transfer will have a positive impact upon the growth of output. This is because whenever $CRR \neq 1/EIS$, the additional income from the transfer is used in consumption and saving in the capital market providing less for risky investment and less for the improvement of the odds of success in the risky investment. In the case of no full insurance and liquidity constraint [Table 2, (iv)], a transfer has a positive effect on investment in the risky technology mostly when $CRR \leq 1/EIS$, but the growth of output is only positive when $CRR=1/EIS \leq 2$. In this case, under liquidity constraint, the effect of the transfer in the growth of consumption is larger (in magnitude) when compared to the perfect capital market case. When full insurance is available for the risky technology (Table 1), the transfer does not impact positively upon growth of output and consumption for any values of EIS . A positive impact on investment in the technology only occurs when the liquidity constraint is binding. However, the level

of investment is higher under perfect capital markets and thus the price of insurance is higher in that regime as well relative to the case of liquidity constraint.

The evidence from Tables 1 and 2 is that a transfer program of the one-size-fits-all, to a set of individuals, regions or nations can have very different effects on the profiles of consumption, investment, saving, price of insurance and economic growth. The different impacts depend on differences regarding insurance for the technology, regime of capital markets and attitudes towards risk aversion and intertemporal substitution. Of course, we have obtained the results fixing the set of parameters $\{\beta, \alpha, z, z_0, p, h, R, \gamma\}$. Sensitivity analysis regarding those parameters may change the quantitative results, in particular the result that under no full insurance and liquidity constraint [Table 2, (iv)], the semi-elasticity of expected growth of output is only positive when $CRRA=1/EIS \leq 2$. However, it does not change our main message that treating all recipient individuals, regions or nations as homogeneous can lead to different and diametrically opposed outcomes.

V. CONCLUSION

We present a simple dynamic model where an individual, region or country has access to a capital market with a risk-free return and a risky technology where the probability of payoff depends on the level of investment in the technology. We consider an allocation problem when there is available full insurance for the technology at a fair price and when there is no full insurance available. We also consider a regime of perfect capital markets and liquidity constraints. We compute the effects of a transfer of date-1 endowment under the alternative regimes and for several values of fundamental preference parameters regarding intertemporal substitution and risk aversion. We show that when the transfer program is provided along with full insurance for the risky investment, growth in consumption and output is not enhanced, and the investment in the risky technology only increases when the liquidity constraint is binding for all plausible levels of intertemporal substitution. When the transfer program is provided without full insurance, the resulting effects become largely sensitive to the parameters in preferences, intertemporal substitution and risk aversion. The growth effects are positive only in special cases: (i) when $CRRA = 1/EIS$ and there are perfect capital markets; or (ii) when $CRRA = 1/EIS \leq 2$ and there are liquidity constraints. When $CRRA \neq 1/EIS$, we show that preferences towards early (late) versus late (early) resolution of risk have an important effect on the allocation of resources, and can render the effects of transfers qualitatively and quantitatively opposed to the case when $CRRA = 1/EIS$.

Further research extending this model to study alternative mechanism designs under asymmetric information is worth pursuing.

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Table 1: Regime of Full Insurance

(i) Full Insurance with Fair Price and Perfect Capital Markets					(ii) Full Insurance with Fair Price and Liquidity Constraint			
<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
ξ_{ky}	0	0	0	0	1.426	1.985	2.907	4.512
ξ_{c1y}	0.493	0.493	0.493	0.493	0.971	0.941	0.902	0.857
ξ_{c2y}	0.493	0.493	0.493	0.493	0.109	0.152	0.221	0.341
ξ_{sy}	-4.610	-4.533	-4.472	-4.428	0	0	0	0
ξ_{gvy}^*	-1.141	-1.141	-1.141	-1.141	-0.950	-0.898	-0.815	-0.677
ξ_{gcy}^*	0	0	0	0	-0.981	-0.885	-0.749	-0.552
$\pi(k)$	0.509	0.509	0.509	0.509	0.466	0.462	0.455	0.445
$\xi_{\pi y}^*$	0	0	0	0	0.066	0.092	0.132	0.201

Table 2: Regime of No Full Insurance

(a) Elasticity of Investment, ξ_{ky}

(iii) No Full Insurance and Perfect Capital Markets					(iv) No Full Insurance and Liquidity Constraint			
<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
2	43.48	2.638	1.412	1.012	30.02	2.668	0.862	0.523
3	-6.122	93.13	5.992	3.365	-55.41	26.47	4.878	2.165
5	-8.513	-18.62	298.2	19.53	-59.70	273.1	6.870	2.428
10	-25.17	-39.81	-87.40	2,071	-81.13	-94.91	9.687	2.528

(b) Elasticity of Date-1 Consumption, ξ_{c1y}

<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
2	-0.144	0.875	0.889	0.886	-3.407	0.579	1.058	1.309
3	1.089	-0.392	0.874	0.900	7.758	-5.608	-1.128	-0.115
5	1.079	1.127	-1.036	0.840	5.242	-54.26	-2.376	-0.678
10	1.101	1.116	1.216	-4.119	3.526	12.28	-3.267	-0.880

(c) Elasticity of Date-2 State- z Consumption, ξ_{c2zy}

<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
2	-0.139	0.133	0.142	0.145	0	0	0	0
3	0.178	-0.266	0.126	0.139	0	0	0	0
5	0.171	0.199	-0.570	0.110	0	0	0	0
10	0.175	0.194	0.248	-1.989	0	0	0	0

(d) Elasticity of Date-2 State- z_0 Consumption, ξ_{c2z_0y}

<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
2	-0.599	0.586	0.639	0.664	0	0	0	0
3	0.720	-1.094	0.526	0.586	0	0	0	0
5	0.667	0.781	-2.254	0.439	0	0	0	0
10	0.667	0.745	0.951	-7.663	0	0	0	0

(e) Elasticity of Saving, ξ_{sy}

<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
2	-1.138	1.145	1.280	1.360	0	0	0	0
3	1.273	-1.970	0.961	1.083	0	0	0	0
5	1.135	1.341	-3.900	0.764	0	0	0	0
10	1.115	1.250	1.602	-12.94	0	0	0	0

Table 2 (continued): Regime of No Full Insurance

(f) Semi-Elasticity of Expected Growth of Income, ξ_{gy}^*

(iii) No Full Insurance and Perfect Capital Markets					(iv) No Full Insurance and Liquidity Constraint			
<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
<i>2</i>	2.452	-0.843	-0.940	-0.971	1.509	-0.922	-1.121	-1.179
<i>3</i>	-1.493	6.145	-0.558	-0.759	-5.880	1.264	-0.747	-1.035
<i>5</i>	-1.583	-2.307	20.44	0.443	-5.960	23.45	-0.555	-1.016
<i>10</i>	-2.556	-3.513	-6.627	134.7	-7.153	-9.265	-0.280	-1.008

(g) Semi-Elasticity of Expected Growth of Consumption, ξ_{cy}^*

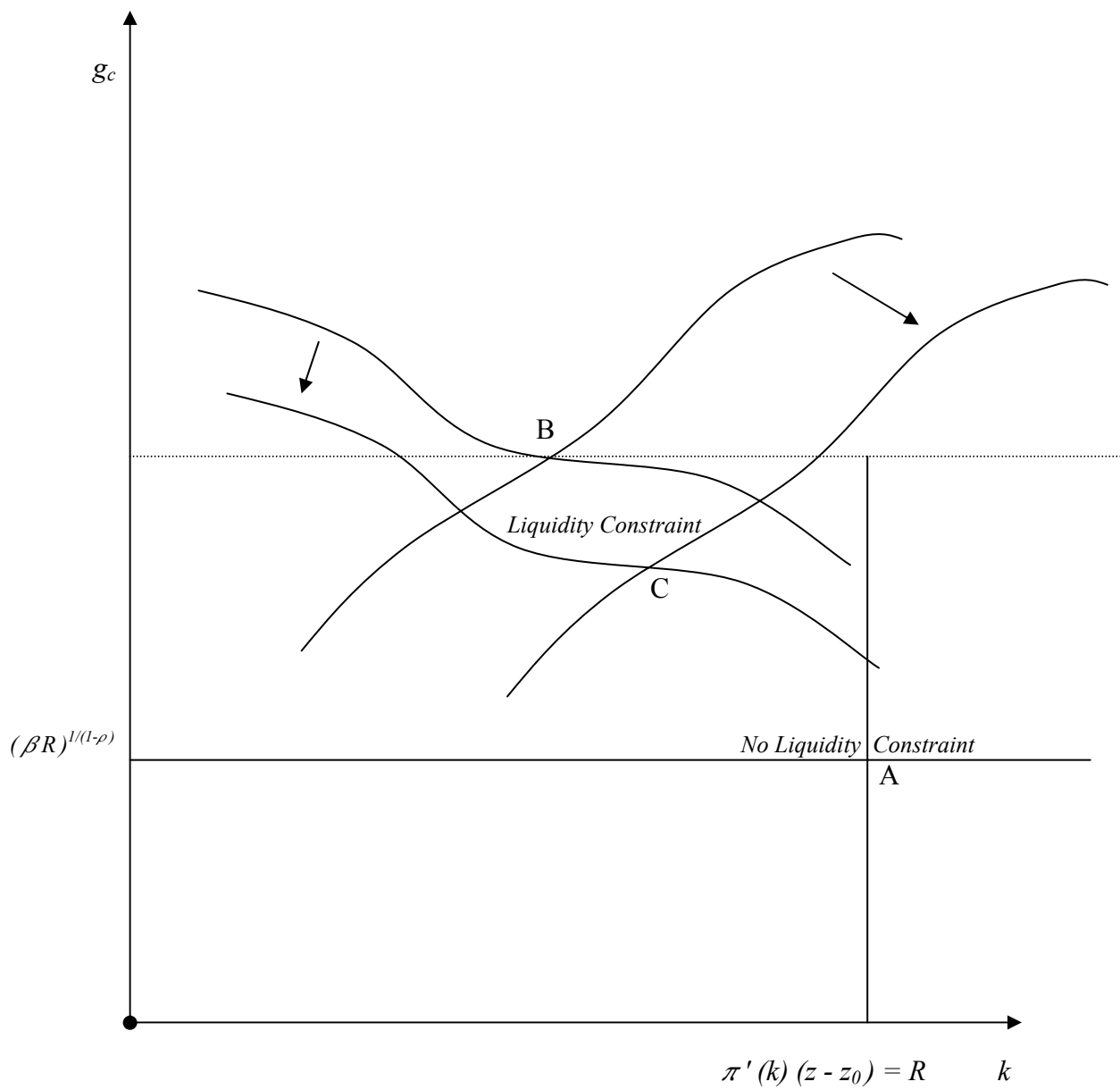
<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
<i>2</i>	5.315	-1.319	-1.437	-1.442	7.469	-0.540	-1.696	-2.571
<i>3</i>	-2.928	11.38	-1.011	-1.330	-14.99	11.32	2.865	0.707
<i>5</i>	-3.184	-4.345	34.71	0.461	-11.23	104.74	5.631	2.396
<i>10</i>	-4.834	-6.333	-11.37	219.4	-9.997	-24.34	7.302	3.054

(h) Fair Price of Insurance, $\pi(k)$

<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
<i>2</i>	0.461	0.460	0.459	0.458	0.502	0.524	0.545	0.560
<i>3</i>	0.441	0.440	0.439	0.438	0.492	0.525	0.554	0.573
<i>5</i>	0.411	0.411	0.410	0.410	0.468	0.515	0.556	0.578
<i>10</i>	0.375	0.374	0.374	0.374	0.433	0.491	0.550	0.580

(i) Semi-Elasticity of Fair Price of Insurance, ξ_{π}^*

<i>EIS</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>	<i>1/2</i>	<i>1/3</i>	<i>1/5</i>	<i>1/10</i>
<i>CRRRA</i>								
<i>2</i>	2.006	0.121	0.065	0.046	1.508	0.140	0.047	0.029
<i>3</i>	-0.270	4.094	0.263	0.147	-2.725	1.390	0.270	0.124
<i>5</i>	-0.350	-0.765	12.23	0.800	-2.795	15.06	0.382	0.140
<i>10</i>	-0.943	-1.490	-3.270	77.46	-3.512	-4.660	0.533	0.146

Figure 1: Regime of Full Insurance, $\partial \gamma > 0$ 

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