The Impact of Financial Openness on the Size of Utility-enhancing Government

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Abstract This paper studies the impact of financial openness on the size of government, and other key economic variables, such as the consumptionwealth ratio, the growth rate of wealth, and welfare, in a two-country world, based on a portfolio approach, assuming that public spending is utility-enhancing. The model suggests that the size of government, the consumption-wealth ratio, and welfare should be higher in an open economy due to a higher productivity and/or less volatility through risk sharing. The theoretical results for the growth rate depend on differences on productivities and consumption-wealth ratios. The empirical evidence based on a sample of 50 countries for the period 1970-2009 broadly supports the main theoretical results of the mode, even though the inclusion of Singapore distorts sometimes the broad picture.

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1 Introduction

The current economic and financial crisis has reignited fundamental concerns about the goodnesses of financial integration. As Aizenman et. al. (2011, pp. 1-2) have put it, "at a broader level, the relationship between financial openness and economic growth is the subject of heated controversy. In contrast to the largely positive perception of trade integration, economists differ sharply about the effect of financial integration on growth." These doubts equally apply to the impact of financial openness on the size of government in the global economy. "Why do more open economies have bigger governments?" was the challenging question Rodrik (1998) addressed in his oft-cited seminal paper. In his own words, "government expenditures are used to provide social insurance against external risk" (p. 997)[1]. Recent evidence confirms that the positive association between trade openness and government size is robust across countries and over time for a large dataset of 143 countries during the period 1950-2000 (Epifani and Gancia, 2009), even though some of the numerous studies have cast doubts on the robustness of the original result[2]. However, the consequences of the tremendous change in the magnitude of cross-border holdings of assets and liabilities that has also taken place in recent years[3] on the size of government have been barely studied.

Instead, previous studies have focused mainly on the relationship between financial openness and economic performance, where international risk sharing has played a predominant role in the analysis. Obstfeld (1994) is a key reference: "the mechanism linking global diversification to growth is the attendant world portfolio shift from safe, but low-yield, capital into riskier, high-yield capital" (p. 1327), thus leading to higher welfare. Greenwood and Jovanovic (1990) have analyzed how financial intermediation can also help to collect information to evaluate projects better thus allocating savings more efficiently: risky high-yield capital generates higher growth. Bencivenga and Smith (1991) have studied how financial intermediaries increase productivity when funds are directed to illiquid, high yield technology, promoting higher growth. Risk sharing through the stock market also induce producers to specialize [Saint-Paul (1992)]: this raises productivity and, when external effects are considered, also growth. In Levine (1991) risk sharing via the stock market encourages investing in less liquid, higher yielding investments thus raising productivity and growth. Devereux and Smith (1994) find, on the contrary, that integrating financial markets internationally may promote

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[1]The pioneer work on the "compensation hypothesis" (as it has become known) goes back at least to Cameron (1978).

[2]Liberati (2007) and Epifani and Gancia (2009) provide good reviews of the literature.

[3]See Lane and Milesi-Ferretti (2007).

or reduce growth and welfare with the presence of external effects on human capital. Pagano (1993) offers a nice survey on these issues.

The literature on the relationship between openness and the size of government suggests that, from a theoretical perspective, openness can be associated to a larger or lower size of the public sector (Liberati, 2007)[4]. According to the compensation hypothesis, more open economies have a larger size of the public sector to compensate for higher external risk[5]. In contrast, the efficiency hypothesis (or conventional wisdom) posits that more open economies are associated to a lower size of the public sector due to an increased mobility of inputs and tax competition[6]. However, the theoretical analysis has usually been restricted to trade openness, while the impact of financial openness on the size of government has received little attention in the theoretical literature[7]. In addition, Liberati (2007, pp. 218-219) has concluded that "as it stands, [...] the empirical literature on the relationship between capital openness and government size is not conclusive, as different studies support a positive relation, the absence of any relation or a negative relation". In fact, he has shown that capital openness and the size of government "are persistently negatively associated", and additionally, that the positive association between trade openness and the size of government is "hardly justified" for a sample of 20 developed countries in the period 1967-2003 (p. 216). Recent research by Kimakova (2009) has found, on the contrary, a positive association between financial and trade openness, and the size of government for a larger sample of 87 countries during the period 1976-2003. As a result,

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[4]See Schulze and Ursprung (1999). Tridimas and Winer (2005) offer a recent survey on the vast literature about the determinants of the size of government. There are also other interesting issues on the size of government, such as why it is measured in terms of spending rather than taxes, or why spending refers to central government rather than general government (Liberati, 2007, p. 220).

[5]Alesina and Wacziarg (1998) show that the link between the size of the public sector and openness can be explained alternatively on the grounds that a higher size of the public sector is related to small economies (due to the economies of scale involved in the provision of public goods) and that small economies are usually more open to trade, so that country size is the variable that can account for the positive relation between the size of the public sector and the openness to trade. Recent research by Ram (2009) suggests, on the contrary, that country size cannot explain the positive relationship between openness and government size for a sample of 150 countries during 41 years. We deal with this issue controlling for country size below.

[6]However, recent research by Koethenbuerger and Lockwood (2010) has shown that more open economies (and thus suffering more tax competition) may be associated to a higher size of government since setting higher capital tax rates in the domestic economy may not create such an enormous capital outflow if countries want to hold a well diversified portfolio.

[7]An important exception is, for instance, Turnovsky (1999), as we point out later.

the empirical evidence found suggests that the relationship between financial openness and government size is far from settled.

Some caution is needed when referring to the size of government. Government spending encompasses different forms of expenditure, such as government consumption, productive spending, public transfers, and so on. In a pioneering work Barro (1990) found that, when public spending is productive, and not subject to congestion, the optimal size of government is equal to the share of government spending in the production function. In case government spending is utility-enhancing then the ratio of public consumption over private consumption would be equal to their relative elasticity[8]. Addressing how financial openness affects government size seems to suggest that how financial portfolio choices are made should be analyzed explicitly. However, a portfolio choice approach has been rarely used to study the impact of financial openness on government size so far.

Turnovsky (1999) is the most closely related theoretical paper analyzing the relationship between financial openness and the size of government, as far as we know: an open economy is theoretically associated to a higher size of government if and only if the country is a net creditor, when government spending is utility-enhancing, or productive and volatility-enhancing, because it is able to export some of its domestic risk. However, he did not analyze empirically this issue. On the contrary, recent work by Erauskin (2011) has found that more open economies are associated both theoretically and empirically with a lower size of productive government in a stochastic small open economy when productive spending is also volatility-reducing[9]: the lower risk associated to more open economies (through risk diversification) implies that the government is less inclined to increase the scale of its activity. Therefore, it becomes evident that how public spending is defined leads unsurprisingly to different results for the optimal size of government. More precisely, given that the bulk of public spending is on goods that, very broadly speaking, contribute to household welfare via the utility function, and they may include, for instance, education, health care, defense, and public order[10], how would the optimal size of government be characterized in the global world economy?

This paper seeks to address both gaps, namely, the absence of a convenient theoretical framework to analyze explicitly in a two-country world economy

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[8] See Turnovsky (1996).

[9] As Andrés, Doménech, and Fatás (2008, p. 571) have pointed out recently, "There is substantial evidence that countries or regions with large governments display less volatile economies, as shown in Galí (1994) and Fatás and Mihov (2001)."

[10] Of course, public spending can also be productive, but we will not deal with it for simplicity.

the impact of financial openness on the size of utility-enhancing government, and the lack of a coherent analysis of the empirical evidence based on the model proposed in the paper, building a full-fledged model that studies the impact of financial openness on the size of government and then testing empirically the main results derived.

Two are the main contributions of this paper. First, this paper studies the impact of financial openness on the size of utility-enhancing government in a two-country world, based on a portfolio approach, thus extending the scope of previous studies. It also analyzes the impact of financial openness on other related key economic variables, such as the consumption-wealth ratio, the growth rate of wealth, and welfare. The framework employed is a general equilibrium model in continuous time with perfect capital mobility where public spending enhances utility, based on Turnovsky [1997, Ch. 11; 1999]. Financial openness offers a wider choice of portfolios thus providing a room for higher productivity. Financial integration would also allow an open economy to diversify some of the country-specific risk achieving less volatility. This would imply a reduction in savings and an increase in private consumption. This combined effect implies that consumption-wealth ratio should be higher in an open economy. The complementarity between public and private consumption[11] suggests that financial openness is associated with a higher size of the public sector. Welfare would also be higher in an open economy. The theoretical results for the growth rate depend on differences in productivities and consumption-wealth ratios among countries. Second, we test the main predictions of the model and we find that they are broadly supported by the empirical evidence, based on a sample of 50 countries (22 industrial and 28 developing countries) for the period 1970-2009, even though the inclusion of Singapore distorts sometimes the broad picture.

The model employed in this paper contains an additional important feature: a crucial difference with previous studies on how this paper measures the degree of financial openness. It is conveniently characterized by the size of portfolio share with respect to domestic wealth. We measure financial openness narrowly as the share of the holdings of foreign capital (direct plus portfolio investment) owned by the domestic economy over domestic wealth. To check the robustness of the relationship we also extend how financial openness is measured. The degree of financial integration is also measured more broadly as the share of the holdings of foreign capital (direct plus portfolio investment) owned by the domestic economy plus the holdings of capital (dir-

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[11]Recent research by Ganelli and Tervala (2009) has found that private consumption responds positively to fiscal shocks, which is explained by the complementarity between public and private consumption, where an increase in public consumption raises the marginal utility of private consumption.

ect plus portfolio investment) by the foreign economy over domestic wealth. In addition, the degree of financial integration is measured in its broadest terms as the share of the holdings of foreign capital (direct plus portfolio investment) and loans owned by the domestic economy plus the holdings of capital (direct plus portfolio investment) and loans by the foreign economy over domestic wealth. Government size is also expressed as a fraction of wealth. Thus how the degree of financial openness and the size of government are measured differs from those measures usually employed in the literature. Previous studies have usually chosen the sum of all or part of the domestic assets and liabilities with respect to other countries over GDP[12]. Two are the reasons for our choice. First, measuring financial openness and the size of government in this way is a direct implication of the model employed in this paper. On top of that, the recent availability of data on international investment positions allows testing directly the variables suggested by the model (the degree of financial openness, the size of government, and so on)[13]. Moreover, we have checked that there is a positive and robust relationship between the measures proposed in this paper and the usual ones in the literature.

The outline of the paper is as follows. In Section 2 the macroeconomic equilibrium is characterized. In Section 3 the results of an open economy are compared to those of a closed economy. The welfare-maximizing size of the public sector is derived in Section 4, and then we discuss whether more open economies will have a higher size of the public sector. Section 5 reviews different measures of financial openness and offers an overview for the sources of data. Section 6 provides the empirical evidence for the model. Finally, we conclude.

2 The world economy

2.1 Basic structure

The world economy consists of two countries, each of them producing only one homogeneous good. On each country there exist a representative agent and a public sector, both with an infinite time horizon. This economy is a real one, that is, there are no nominal assets, such as money, different financial assets, etc. Unstarred variables refer to domestic economy, whereas starred variables refer to the foreign economy. This model will focus on the

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[12]See Lane and Milesi-Ferretti (2007), for instance.

[13]The data are mainly provided by the International Monetary Fund, and Lane and Milesi-Ferretti (2007), as shown below.

domestic economy since the results for the foreign economy are very similar.

The homogeneous good produced by both countries can be either consumed or invested in capital without having to incur in any kind of adjustment costs. We assume that domestic production can be obtained using only domestic capital, K, through an AK function, and that it can be expressed through a first order stochastic differential equation, so that production flow dY (the variation of the state variable) is not completely determined, but subject to a stochastic disturbance

$$dY = \alpha K dt + \alpha K dy,$$

where $\alpha > 0$ is the (constant) marginal physical product of capital and dy represents a proportional domestic productivity shock. More precisely, dy is the increment of a stochastic process y. Those increments are temporally independent and are normally distributed, and they satisfy that $E(dy) = 0$ and $E(dy^2) = \sigma_y^2 dt$. We omit, for convenience, formal references to time, although those variables depend on time. We must note that dY indicates the flow of production, instead of Y, as is ordinarily done in stochastic calculus.

The foreign economy is structured symmetrically to the domestic economy. Thus, foreign production is carried out using capital domiciled abroad, K^*, with a production function very similar to the one in the domestic economy

$$dY^* = \alpha^* K^* dt + \alpha^* K^* dy^*,$$

where $\alpha^* > 0$ is the marginal physical product of capital and dy^* represents a proportional foreign productivity shock. We should note that dy^* is the increment of a stochastic process y^*. Those increments are temporally independent and are distributed normally, satisfying that $E(dy^*) = 0$ and that $E(dy^{*^2}) = \sigma_{y^*}^2 dt$.

Both domestic capital, K, and foreign capital, K^*, can be owned by the domestic agent or the foreign agent. The subscript d denotes the holdings of assets of the domestic agent and the subscript f denotes the holdings of assets of the foreign agent. So it must be satisfied that

$$
\begin{aligned}
K &= K_d + K_f \\
K^* &= K_d^* + K_f^*.
\end{aligned}
$$

The wealth of the domestic agent, W, and the wealth of the foreign agent, W^*, therefore will be

$$
\begin{aligned}
W &= K_d + K_d^* & (1) \\
W^* &= K_f + K_f^*. & (2)
\end{aligned}
$$

2.2 Domestic economy

2.2.1 The maximization problem

The preferences of the domestic representative agent are represented by a constant elasticity of substitution (or isoelastic) intertemporal utility function where she obtains utility from private consumption, C, and from public consumption, G

$$E_0 \int_0^\infty \frac{1}{\gamma}(CG^\eta)^\gamma e^{-\beta t} dt \tag{3}$$
$$-\infty < \gamma < 1; \eta > 0; \gamma\eta < 1; \gamma(1+\eta) < 1.$$

The welfare of the domestic agent in period 0 is the expected value of the discounted sum of instantaneous utilities, conditioned on the set of disposable information in period 0. The parameter β is a positive subjective discount rate (or rate of time preference). For the isoelastic utility function the Arrow-Pratt coefficient of relative risk aversion is given by the expression $1 - \gamma$. When $\gamma = 0$ this function corresponds to the logarithmic utility function. The empirical evidence suggests a high degree of relative risk aversion, so that $\gamma < 0$ (Campbell, 1996). The parameter η measures the influence of public consumption on welfare. We assume that both private consumption and public consumption generate a positive marginal utility, so that $\eta > 0$. The other restrictions on the utility function are necessary to ensure concavity with respect to private consumption and public consumption.

The domestic agent consumes at a deterministic rate $C(t)dt$ in the instant dt and must pay the corresponding taxes and thus the dynamic budget restriction can be expressed in the following way

$$dW = [\alpha K_d + \alpha^* K_d^*] \, dt + [\alpha K_d dy + \alpha^* K_d^* dy^*] - Cdt - dT, \tag{4}$$

where dT denotes the taxes the domestic representative agent must pay to the public sector. The structure of taxes will be detailed below.

There is a public sector besides the domestic representative agent. Public sector spending, dG, increases with wealth, so we can achieve a balanced growth path. Public spending evolves according to

$$dG = gWdt + Wdz, \tag{5}$$

where $g = G/W$ is the size of the public sector and dz is the increment of a stochastic process z. Those increments are temporally independent and are normally distributed, satisfying that $E(dz) = 0$ and $E(dz^2) = \sigma_z^2 dt$.

Public sector spending is financed solely via tax collection: the public sector equilibrates its budget continuously, that is,

$$dT = dG. \tag{6}$$

Combining equations (5) and (6), and plugging them into (4), we get the following restriction for the resources of the domestic economy

$$dW = [\alpha K_d + \alpha^* K_d^* - C - gW]\, dt + [\alpha K_d dy + \alpha^* K_d^* dy^* - W dz]\,. \tag{7}$$

Let us remember that the holding of assets by the domestic agent is subject to the domestic wealth equation (1). If we define the following variables for the domestic agent

$$
\begin{aligned}
n_d &\equiv \frac{K_d}{W} = \text{ share of the domestic portfolio materialized} \\
&\quad\text{in domestic capital} \\
n_d^* &\equiv \frac{K_d^*}{W} = \text{ share of the domestic portfolio materialized} \\
&\quad\text{in foreign capital,}
\end{aligned}
$$

equation (1) can be expressed more conveniently as

$$1 = n_d + n_d^* \tag{8}$$

and substituting those variables into the budget constraint (7) we obtain the following dynamic restriction for the resources of the domestic economy

$$\frac{dW}{W} = \left[\alpha n_d + \alpha^* n_d^* - \frac{C}{W} - g\right] dt + [\alpha n_d dy + \alpha^* n_d^* dy^* - dz]\,. \tag{9}$$

This equation can be more conveniently expressed as

$$\frac{dW}{W} = \psi dt + dw, \tag{10}$$

where the deterministic and stochastic parts of the rate of accumulation of assets, dW/W, can be expressed in the following way

$$\psi \equiv n_d\left[\alpha - \alpha^*\right] + \alpha^* - g - \frac{C}{W} \equiv \rho - g - \frac{C}{W} \tag{11}$$

$$dw \equiv n_d\left[\alpha dy - \alpha^* dy^*\right] + \alpha^* dy^* - dz, \tag{12}$$

where $\rho \equiv \alpha n_d + \alpha^* n_d^* \equiv n_d\left[\alpha - \alpha^*\right] + \alpha^*$ denotes the gross rate of return of the asset portfolio.

2.2.2 Equilibrium

Now the case where the public sector acts as a central planner is analyzed. The objective of the central planner consists in choosing the path of private consumption and portfolio shares that maximizes the expected value of the intertemporal utility function (3) of the domestic representative agent, subject to $W(0) = W_0$, (10), (11), and (12). This optimization is a stochastic optimum control problem.[14] Initially we assume that the public sector establishes an arbitrarily exogenous size of the public sector, g. We analyze the case in which such a size is chosen optimally in section 4.

The macroeconomic equilibrium is derived in Appendix A. The equilibrium portfolio shares and the consumption-wealth ratio in the domestic open economy are given by

$$n_d = \frac{\alpha - \alpha^*}{[1 - \gamma(1 + \eta)]\Delta} + \frac{\alpha^{*2}\sigma_{y^*}^2 - \alpha\alpha^*\sigma_{yy^*} + \alpha\sigma_{yz} - \alpha^*\sigma_{y^*z}}{\Delta} \tag{13}$$

$$n_d^* = 1 - n_d \tag{14}$$

$$\left(\frac{C}{W}\right)_o = \frac{1}{(1 - \gamma)(1 + \eta)}\left[\beta - \gamma(1 + \eta)(\rho - g)\right.$$
$$\left. + 0.5\gamma(1 + \eta)[1 - \gamma(1 + \eta)]\sigma_{w,o}^2\right], \tag{15}$$

where

$$\Delta = \alpha^2\sigma_y^2 - 2\alpha\alpha^*\sigma_{yy^*} + \alpha^{*2}\sigma_{y^*}^2 \tag{16}$$

$$\sigma_{w,o}^2 = n_d^2\alpha^2\sigma_y^2 + 2n_d n_d^*\alpha\alpha^*\sigma_{yy^*} + n_d^{*2}\alpha^{*2}\sigma_{y^*}^2 + \sigma_z^2$$
$$- 2n_d\alpha\sigma_{yz} - 2n_d^*\alpha^*\sigma_{y^*z}. \tag{17}$$

Do note that neither the expression Δ nor the variance of the rate of accumulation of domestic assets, $\sigma_{w,o}^2$, can be negative and the variables with the subscript o refer to values in an open economy. Appendix B shows that the second order conditions are satisfied.

Then, the equilibrium rate of wealth accumulation of the open domestic economy follows the stochastic process

$$\frac{dW}{W} = \psi_o dt + dw_o, \tag{18}$$

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[14]To solve problems of stochastic optimum control see, for example, Kamien and Schwartz (1991, Section 22), Malliaris and Brock (1982, Ch. 2), Obstfeld (1992), or Turnovsky (1997, Ch. 9; 2000, Ch. 15).

where the deterministic and stochastic components are, respectively

$$\psi_o = \frac{1}{(1-\gamma)(1+\eta)}\{(1+\eta)(\rho-g)-\beta$$
$$-0.5\gamma(1+\eta)[1-\gamma(1+\eta)]\sigma_{w,o}^2\} \tag{19}$$
$$dw_o = n_d\alpha dy + n_d^*\alpha^* dy^* - dz. \tag{20}$$

Even though with more general utility functions the optimal portfolio shares and consumption-wealth ratio will be functions of time, in this model all those variables are constant because the utility function exhibits constant relative risk aversion, the production function is linear, and the mean and variances of the underlying stochastic processes are stationary: the equilibrium is characterized by balanced real growth, where all the (real) assets grow at the same rate, and by constant consumption-wealth ratio and portfolio shares. The same is also true for the foreign economy, as we shall see below.

2.3   Welfare

Economic welfare is measured by the value function we have used to solve the problem of intertemporal optimization, given by equation (52) in Appendix B

$$V(W) = \frac{g^{\eta\gamma}}{\gamma(1+\eta)}\left(\frac{C}{W}\right)^{\gamma-1}W^{\gamma(1+\eta)}. \tag{21}$$

From the total differential of equation (21) we obtain, after some algebra, that

$$\frac{dV}{V} = (\gamma-1)\frac{d(C/W)}{C/W} + \gamma\eta\frac{dg}{g}, \tag{22}$$

where we can observe that changes in the optimal consumption-wealth ratio and the (exogenous) size of the public sector have an impact on welfare.

First, a higher optimal consumption-wealth ratio can improve or deteriorate the welfare of the domestic economy. That is due to the fact that the value function can take either positive or negative values, depending on the sign of the coefficient γ. Since C/W and g are positive in equation (21) then $\gamma V(W) > 0$. For the case $\gamma < 0$, anything that increases the optimal consumption-wealth ratio raises welfare. Thus, for example, a higher subjective discount rate, increasing the optimal consumption-wealth ratio, generates higher welfare if $\gamma < 0$.

Second, the size of the public sector is an important factor influencing welfare. Do note that the optimal consumption-wealth ratio, given by equation (15), also depends on the size of the public sector, g. Therefore, the impact of changes in the size of the public sector on welfare is given by

$$\frac{dV}{V} = \gamma \left[\eta - \frac{g}{C/W} \right] \frac{dg}{g}.$$

Thus, a higher size of the public sector can increase or reduce welfare, even though it reduces unambiguously the growth rate. The crucial point lies on whether $g \lesseqgtr \eta C/W$. If $g < \eta C/W$, an increase in the size of the public sector raises welfare. That is due to the fact that the marginal utility derived from public consumption is higher than the marginal utility derived from private consumption. If $g = \eta C/W$, an increase in the size of the public sector does not change welfare because the marginal utility derived from public consumption is equal to the marginal utility derived from private consumption: it is the size of the public sector that maximizes welfare, as we shall see below. Finally, if $g > \eta C/W$, an increase in the size of the public sector reduces welfare because the marginal utility derived from public consumption is lower than the marginal utility derived from private consumption.

2.4 Foreign economy

2.4.1 The maximization problem

The problem facing the foreign representative agent can be formulated in an analogous way. Her preferences are represented by the following intertemporal utility function

$$E \int_0^\infty \frac{1}{\gamma^*} (C^* G^{*\eta^*})^{\gamma^*} e^{-\beta^* t} dt$$
$$-\infty \;\; < \;\; \gamma^* < 1; \eta^* > 0; \gamma^* \eta^* < 1; \gamma^*(1 + \eta^*) < 1.$$

The equation of the rate of accumulation of wealth of the foreign representative agent can be expressed as

$$\frac{dW^*}{W^*} = \psi^* dt + dw^*,$$

where

$$
\begin{aligned}
\psi^* &\equiv n_f \alpha + n_f^* \alpha^* - g^* - \frac{C^*}{W^*} \equiv \rho^* - g^* - \frac{C^*}{W^*} \\
dw^* &\equiv n_f \alpha dy + n_f^* \alpha^* dy^* - dz^*.
\end{aligned}
$$

2.4.2 Equilibrium

The equilibrium portfolio shares and consumption-wealth ratio in the foreign economy are

$$
\begin{aligned}
n_f &= \frac{\alpha - \alpha^*}{[1 - \gamma^*(1 + \eta^*)]\,\Delta} + \frac{\alpha^{*2}\sigma_{y^*}^2 - \alpha\alpha^*\sigma_{yy^*} + \alpha\sigma_{yz^*} - \alpha^*\sigma_{y^*z^*}}{\Delta} \\
n_f^* &= 1 - n_f \\
\left(\frac{C^*}{W^*}\right)_o &= \frac{1}{(1 - \gamma^*)(1 + \eta^*)}\left\{\beta^* - \gamma^*(1 + \eta^*)(\rho^* - g^*)\right. \\
&\quad \left. - 0.5\gamma^*(1 + \eta^*)\left[\gamma^*(1 + \eta^*) - 1\right]\sigma_{w^*,o}^2\right\},
\end{aligned}
$$

where

$$
\begin{aligned}
\sigma_{w^*,o}^2 &= n_f^2\alpha^2\sigma_y^2 + 2n_f n_f^*\alpha\alpha^*\sigma_{yy^*} + n_f^{*2}\alpha^{*2}\sigma_{y^*}^2 \\
&\quad + \sigma_{z^*}^2 - 2n_f\alpha\sigma_{yz^*} - 2n_f^*\alpha^*\sigma_{y^*z^*}.
\end{aligned}
$$

The equilibrium rate of accumulation of wealth in the foreign economy follows the stochastic process

$$
\frac{dW^*}{W^*} = \psi_o^* dt + dw_o^*
$$

where its deterministic and stochastic components are, respectively

$$
\begin{aligned}
\psi_o^* &= \frac{1}{(1 - \gamma^*)(1 + \eta^*)}\left\{(1 + \eta^*)(\rho^* - g^*) - \beta^*\right. \\
&\quad \left. - 0.5\gamma^*(1 + \eta^*)\left[\gamma^*(1 + \eta^*) - 1\right]\sigma_{w^*,o}^2\right\} \\
dw_o^* &= n_f\alpha dy + n_f^*\alpha^* dy^* - dz^*.
\end{aligned}
$$

3 Open economy versus closed economy

Now we describe the behavior of the domestic economy if it were closed in order to compare the results of an open economy with those of a closed economy. In a model of perfect capital mobility such as this, where domestic and foreign assets are traded without restrictions, the share of the domestic portfolio materialized in foreign capital, n_d^*, is conveniently characterized to approximate the degree of financial openness of the domestic economy. More on this crucial issue will be discussed below in Section 4. Since our emphasis

is on the trade of assets, then we call closed economy the situation where there is no trade of assets. However, we should bear in mind that what we call closed economy is compatible with positive amounts of exports and imports, but subject to the restriction that the trade of goods must be balanced. In the case of a closed economy, the equilibrium solution [equations (15), (17), (19), and (20)] will be given by the expressions

$$
\left(\frac{C}{W}\right)_c = \frac{1}{(1-\gamma)(1+\eta)} \{\beta - \gamma(1+\eta)(\alpha-g)
$$
$$
+0.5\gamma(1+\eta)[1-\gamma(1+\eta)]\sigma^2_{w,c}\} \tag{23}
$$
$$
\sigma^2_{w,c} = \alpha^2\sigma^2_y + \sigma^2_z - 2\alpha\sigma_{yz} \tag{24}
$$
$$
\psi_c = \frac{1}{(1-\gamma)(1+\eta)} \{(1+\eta)(\alpha-g) - \beta
$$
$$
-0.5\gamma(1+\eta)[1-\gamma(1+\eta)]\sigma^2_{w,c}\} \tag{25}
$$
$$
dw_c = \alpha dy - dz,
$$

where the variables with the subscript c refer to values in a closed economy.

Now it is useful to calculate the difference between the variance of the growth rate in an open economy and in a closed economy. Thus if we subtract equation (24) from equation (17) we obtain, after some algebra, that

$$
\sigma^2_{w,o} - \sigma^2_{w,c} = \Delta n^*_d \left(n^*_d - 2\tilde{n}^*_d\right), \tag{26}
$$

where

$$
\tilde{n}^*_d = \frac{\alpha^2\sigma^2_y - \alpha\alpha^*\sigma_{yy^*} - \alpha\sigma_{yz} + \alpha^*\sigma_{y^*z}}{\Delta},
$$

is the share of the domestic portfolio materialized in foreign capital that minimizes the variance of the growth rate given by equation (17). No clear-cut results can be given on whether the variance of the growth rate is lower for an open economy or not. However, one can think that it will be lower in an open economy since it is is more able to diversify away country-specific risks.

Subtracting equation (23) from equation (15) we obtain, using equation (26), that, after some algebra, the difference between the consumption-wealth ratio in an open economy and a closed economy is equal to

$$
\left(\frac{C}{W}\right)_o - \left(\frac{C}{W}\right)_c = -\frac{1}{1-\gamma} \left\{0.5\gamma\left[1-\gamma(1+\eta)\right]\Delta n^{*2}_d\right\}. \tag{27}
$$

The sign of the difference between both consumption-wealth ratios depends only on the value of the parameter γ. Thus, if $\gamma < 0$, then the consumption-wealth ratio will be unambiguously higher in an open economy than in a closed economy, no matter what the values of portfolio shares are, provided of course that $n_d^* \neq 0$. An easy way to explain that result can be found, without loss of generalization, focusing on the case $n_d = \widetilde{n}_d$, where

$$\widetilde{n}_d = 1 - \widetilde{n}_d^* = \frac{\alpha^{*2}\sigma_{y^*}^2 - \alpha\alpha^*\sigma_{yy^*} + \alpha\sigma_{yz} - \alpha^*\sigma_{y^*z}}{\Delta}, \qquad (28)$$

denotes the share of the domestic portfolio materialized in domestic capital that minimizes the variance of the growth rate of wealth [equation (17)]. When $n_d = \widetilde{n}_d$ we know from equation (26) that the variance of the growth rate in an open economy is lower than in a closed economy, $\sigma_{w,o}^2 < \sigma_{w,c}^2$. Totally differentiating equation (15) it can be easily shown that a reduction in the variance of the growth rate is equivalent to an increase in the gross rate of return of the asset portfolio, ρ, of $0.5\left[1 - \gamma(1+\eta)\right]$. A higher gross rate of return of the asset portfolio, ρ, raises (reduces) consumption-wealth ratio if $\gamma < (>)0$ and does not change if $\gamma = 0$ [see equation (15) above]. The result depends on the sum of two opposite standard effects, substitution and income effects. A higher gross rate of return of the asset portfolio has always a negative substitution effect since consumption becomes less attractive whereas investment is more attractive. The income effect on the consumption-wealth ratio, originated by a higher gross rate of return of the asset portfolio, is equal to unity: it makes possible to raise both actual and future consumption. If $\gamma < (>)0$, income (substitution) effect dominates substitution (income) effect and if $\gamma = 0$ the two effects compensate each other. From here onwards whenever a result depends on the sign of the parameter γ, we shall only focus on the case where $\gamma < 0$, for being the most relevant situation empirically (Campbell, 1996). Since a lower variance of the growth rate originates a stronger positive income effect than the negative substitution effect on the consumption-wealth ratio, then the consumption-wealth ratio in an open economy will be higher than in a closed economy for $\gamma < 0$. In an open economy a higher level of welfare is achieved choosing a higher consumption-wealth ratio, provided that $\gamma < 0$, as we saw in Section 2.3. Additionally, the higher the value of the optimal share of the domestic portfolio materialized in foreign capital, n_d^*, the higher the difference between the results of an open economy with those of a closed economy, other things being equal.

It should be noted, however, that, despite the previous reasoning, equation (27) does not rule out other cases. For instance, an open economy can be, on the one hand, more volatile than a closed economy, but in exchange

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for that it can obtain, on the other hand, a higher return for the portfolio, ρ, thus maximizing welfare. This would also imply of course that consumption-wealth ratio would be higher in an open economy than in a closed economy.

The growth rate in an open economy is compared to that in a closed economy departing from equation (11) corresponding to an open economy and subtracting from it that corresponding to a closed economy [equation (25)]

$$\psi_o - \psi_c = n_d^*(\alpha^* - \alpha) - \left[\left(\frac{C}{W}\right)_o - \left(\frac{C}{W}\right)_c\right]. \tag{29}$$

The growth rate in an open economy can be higher than, equal to or lower than that in a closed economy, depending on the signs of the two terms in (29). In case both economies are completely symmetric, that is, $\alpha = \alpha^*$, the growth rate in an open economy will be lower than that in a closed economy when $\gamma < 0$ since the consumption-wealth ratio in an open economy is higher than that in a closed economy. However, the opposite may also be true in case the impact of higher foreign productivity is stronger than that produced by a higher consumption-wealth ratio in an open economy.

It is easy to show that welfare is unambiguously higher in an open economy than in a closed economy, simply going back to the value function given by equation (21): the consumption-wealth ratio in an open economy will be higher than that in a closed economy for $\gamma < 0$ [see equation (27)]. In fact, the result applies to all values of the parameter γ, regardless of the values of productivities, α and α^*, across countries.

4   The optimal size of the public sector

We have so far compared the results in an open economy with those in a closed economy assuming an exogenous size of the public sector. Now we obtain the size of the public sector that maximizes the welfare of the domestic representative agent or, for short, the optimal size of the public sector. Then the results of an open economy are compared to those of a closed economy.

Formally, the expression in the right hand side of the Bellman equation (45) in Appendix A is partially differentiated with respect to g, where $G = gW$, to calculate the optimal size of the public sector

$$\frac{\eta}{g}C^\gamma (gW)^{\eta\gamma} - V'(W)W = 0,$$

which combining with the first order condition equation (46) implies that the optimal size of the public sector, $\widehat{g}$, must satisfy the following condition

$$\hat{g} = \eta \frac{C}{W}, \tag{30}$$

which is identical to Turnovsky (1996, p. 60; 1999, p. 888).[15] Equation (30) implies that the marginal utility of public consumption must be equal to the marginal utility of private consumption when both public and private consumption are optimally chosen.

Combining equation (30) with (15) we can calculate the optimal size of the public sector, the consumption-wealth ratio, and the growth rate when public consumption is optimally chosen in an open economy

$$
\begin{aligned}
\hat{g}_o &= \frac{\eta}{[1 - \gamma(1 + \eta)]\,(1 + \eta)} \{\beta - \gamma(1 + \eta)\rho \\
&\quad + 0.5\gamma(1 + \eta)\,[1 - \gamma(1 + \eta)]\,\sigma_{w,o}^2\} \tag{31} \\
\left(\frac{C}{W}\right)_o &= \frac{1}{[1 - \gamma(1 + \eta)](1 + \eta)} \{\beta - \gamma(1 + \eta)\rho \\
&\quad + 0.5\gamma(1 + \eta)\,[1 - \gamma(1 + \eta)]\,\sigma_{w,o}^2\} \tag{32} \\
\psi_o &= \frac{1}{1 - \gamma(1 + \eta)} \{\rho - \beta - 0.5\gamma(1 + \eta)\,[1 - \gamma(1 + \eta)]\,\sigma_{w,o}^2\}. \tag{33}
\end{aligned}
$$

Do note that whenever we refer to the optimal size of the public sector in general we will use the term $\widehat{g}$ and whenever we refer only to the optimal size in an open economy we will use $\widehat{g}_o$.

In addition, we obtain the optimal size of the public sector, the consumption-wealth ratio, and the growth rate when public consumption is optimally chosen in a closed economy

$$
\begin{aligned}
\hat{g}_c &= \frac{\eta}{[1 - \gamma(1 + \eta)]\,(1 + \eta)} \{\beta - \gamma(1 + \eta)\alpha \\
&\quad + 0.5\gamma(1 + \eta)\,[1 - \gamma(1 + \eta)]\,\sigma_{w,c}^2\} \tag{34} \\
\left(\frac{C}{W}\right)_c &= \frac{1}{[1 - \gamma(1 + \eta)](1 + \eta)} \{\beta - \gamma(1 + \eta)\alpha \\
&\quad + 0.5\gamma(1 + \eta)\,[1 - \gamma(1 + \eta)]\,\sigma_{w,c}^2\} \tag{35} \\
\psi_c &= \frac{1}{1 - \gamma(1 + \eta)} \{\alpha - \beta - 0.5\gamma(1 + \eta)\,[1 - \gamma(1 + \eta)]\,\sigma_{w,c}^2\} \tag{36}
\end{aligned}
$$

---

[15] We should note that the optimal size of the public sector, $\hat{g}$, is not exactly identical to that shown in Turnovsky (1999). However, it is identical in the sense that in both cases the optimal ratio of public consumption to private consumption is given by $G/C = \eta$.

4.1 Open economy versus closed economy

Focusing first on the optimal size of the public sector, if we subtract equation (34) from equation (31) we obtain using equation (26), after some algebra, that

$$\hat{g}_o - \hat{g}_c = -0.5\eta\gamma\Delta n_d^{*2}. \tag{37}$$

The sign of the result in equation (37) depends only on the parameter γ: the size of the public sector in an open economy will be higher than that in a closed economy for $\gamma < 0$. Let us see why. Without loss of generalization, focusing again on the case $n_d = \widetilde{n}_d$, where $\widetilde{n}_d$ is the variance-minimizing share of the domestic portfolio [see equation (28)], the variance in the growth rate in an open economy is lower than that in a closed economy, $\sigma_{w,o}^2 < \sigma_{w,c}^2$ [see equation (26)]. Since a reduction of the variance in the growth rate is equivalent to an increase in the gross rate of return of the asset portfolio, that, in turn, originates a stronger positive income effect on the public consumption-wealth ratio than the negative substitution effect: the size of the public sector in an open economy will be higher than in a closed economy. More openness is associated to less volatility, and this, in turn, increases private consumption. As public and private consumption are complementary, government consumption increases as well[16]. Furthermore, this result is similar to Turnovsky (1999) for a logarithmic utility function. However, it should be emphasized that our result has been shown for empirically the most relevant case that $\gamma < 0$, no matter what the values of portfolio shares are, while Turnovsky´s depends on the creditor or debtor position of the country.

As before, in spite of the previous reasoning, equation (37) does not rule out other cases. For example, an open economy, being more volatile than a closed economy, can obtain a higher return for the portfolio, ρ. Then the size of government would also be higher in an open economy than in a closed economy.

It should be noted that financial openness has been conveniently characterized by the share of the domestic portfolio materialized in foreign capital, n_d^*. A higher value of the portfolio share denotes in this paper a higher degree of financial openness[17]. Of course pointing out that an open economy will have a larger size of the public sector than a closed economy is not equivalent to saying that there is a positive relationship between the degree of financial openness and the size of government. The latter is more relevant

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[16]In addition, the higher the value of the optimal share of the domestic portfolio materialized in foreign capital, n_d^*, the higher the difference between the optimal size of the public sector in an open economy with that in a closed economy is.

[17]More on this is discussed in the next section.

and realistic to be empirically tested, while the former is the result we have just obtained. However, both results are, in fact, very closely related. Let us see why. For simplicity, and without loss of generalization, we focus on the impact of changes in domestic production risk on an open economy, ignoring the covariance terms. Differentiating (13) with respect to σ_y^2 we obtain

$$\frac{\partial n_d}{\partial \sigma_y^2} = -\frac{\alpha^2 n_d}{\Delta} < 0, \tag{38}$$

that is, an increase in the variance of the domestic productivity shock reduces the share of domestic holdings of domestic capital. Then the effect of an increase of production risk on the rate of return of domestic portfolio, $\rho \equiv \alpha n_d + \alpha^* n_d^*$, is given by

$$\frac{\partial \rho}{\partial \sigma_y^2} = (\alpha - \alpha^*) \frac{\partial n_d}{\partial \sigma_y^2}, \tag{39}$$

where the sign of the derivative depends on the difference of marginal products of capital, $\alpha - \alpha^*$. In addition, the impact on the variance of the growth rate, $\sigma_{w,o}^2$ [equation (17)], would be given, after some algebra, by

$$\frac{\partial \sigma_{w,o}^2}{\partial \sigma_y^2} = \alpha^2 n_d \left(2\widetilde{n}_d - n_d\right), \tag{40}$$

This means that a higher variance of domestic productivity shocks can increase or reduce the variance of the growth rate. On the one hand, a higher variance of domestic productivity shocks increases the variance of the growth rate directly, but on the other hand, reduces the variance of the growth rate shifting investment from domestic capital to foreign capital. Therefore, the impact of a change in domestic risk on the consumption-wealth ratio (32) is equal to

$$\frac{\partial (C/W)}{\partial \sigma_y^2} = -\frac{\gamma}{1-\gamma} \left(\frac{\partial \rho}{\partial \sigma_y^2} - 0.5 \left(1 - \gamma\right) \frac{\partial \sigma_{w,o}^2}{\partial \sigma_y^2} \right). \tag{41}$$

Substituting (38), (39), and (40) in expression (41), this is reduced to

$$\frac{\partial (C/W)}{\partial \sigma_y^2} = 0.5\gamma\alpha^2 n_d^2. \tag{42}$$

We see in (42) that consumption-wealth ratio falls with the variance for $\gamma < 0$, and increases otherwise. This implies, via (30), a similar result for the government size:

$$\frac{\partial (G/W)}{\partial \sigma_y^2} = 0.5\gamma\alpha^2 n_d^2.$$

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Government size diminishes as variance increases for $\gamma < 0$, and increases otherwise. In a nutshell, if production risk diminishes, portfolio share increases, and this raises consumption-wealth ratio, and government size. Thus higher openness is positively related with consumption-wealth ratio and government size, as we have argued above.[18]

Similarly, since the optimal size of the public sector is given by equation (30) and the difference in the size of the public sector by equation (37), the difference between the consumption-wealth ratio in an open economy [equation (32)] and that in a closed economy [equation (35)] would be given by

$$\left(\frac{C}{W}\right)_o - \left(\frac{C}{W}\right)_c = -0.5\gamma\Delta n_d^{*2}.$$

Consumption-wealth ratio in an open economy will be higher than in a closed economy, for $\gamma < 0$, as in Section 3. Analogous results to the case when the size of the public sector was exogenously given apply for the impact of financial openness on the growth rate and welfare. Thus, the growth rate will be higher in a closed economy than in an open economy for similar productivities, but the opposite may also be true. Welfare is unambiguously higher in an open economy.

5 The degree of financial openness and data sources

Different measures for the degree of financial openness have been suggested by the literature recently[19]. Thus some discussion is needed for the choice to measure the degree of financial openness. Lane and Milesi-Ferretti (2007) employ two *de facto* measures to capture the scale of cross-border financial integration. The first refers to the stock of external assets and liabilities with respect to the GDP. The second is based on portfolio equity and foreign direct investment stocks (both assets and liabilities) with respect to GDP. Chinn and Ito (2008) propose a *de iure* index to capture the extent and intensity of capital controls, mainly based on the IMF´s *Annual Report on Exchange Arrangements and Exchange Restrictions*. We are inclined to use the measures proposed by Lane and Milesi-Ferretti (2007) for two reasons.

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[18]Alternatively, one could introduce some type of friction, e.g. a tax on financial transactions, that could be varied to reflect changing barriers to international equity investment to relate positively financial openness, and consumption-wealth ratio and government size.

[19]See Chinn and Ito (2008) for a recent discussion on this issue.

On the one hand, those measures capture better the major and increasing change in the degree of financial integration. Instead, the index suggested by Chinn and Ito (2008) changes slowly as it captures "the extent and intensity of capital controls", from a *de iure* perspective (p. 311). Second, the model employed suggests that the relevant variable should be expressed in terms of domestic wealth, W, which is defined in equation (1). The approach followed by Lane and Milesi-Ferretti (2007) is more convenient for that purpose.

Therefore, three measures for the degree of financial openness are proposed for this paper, broadly inspired Lane and Milesi-Ferretti (2007)[20]. That will also allow to check the robustness of the relationships analyzed. However, please note that their ratios are expressed with respect to GDP, while in this paper, they are expressed with respect to domestic wealth, W. The latter is the approach we follow to be internally consistent with the results of our model. We will show the relationship between both ways of measuring it below.

- Measure 1 (narrow), FO_1: The share of the domestic portfolio materialized in foreign capital (direct and portfolio equity assets) over domestic wealth. This would be the measure directly suggested by the theoretical model.

- Measure 2 (broader), FO_2: The ratio of the stock of direct and portfolio equity assets and liabilities for the domestic economy over domestic wealth.

- Measure 3 (broadest), FO_3: The ratio of the stock of all external assets and liabilities of the domestic economy over domestic wealth. Those assets and liabilities include the stock of direct plus portfolio equity, portfolio debt investment, other investment assets (general government, banks, and others), reserve assets (minus gold) and financial derivatives.

Thus, higher values of the measure indicate a higher degree of financial openness. Using three different measures could imply divergent results. However, as we will show below, things are much simpler than it seems.

The data set employed to test the main results of the model covers 50 countries for the period 1970-2009. We will distinguish between industrial and developing countries, following seminal contributions in this area[21]. Industrial countries include Austria, Australia, Belgium, Canada, Denmark,

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[20]While they suggest two measures, we employ three.

[21]See, for instance, Lane and Milesi-Ferretti (2001, 2007), and Kraay, Loayza, Servén, and Ventura (2005). This distinction is acknowledged to be somewhat arbitrary.

Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, The Netherlands, Norway, New Zealand, Spain, Portugal, Sweden, Switzerland, United Kingdom, and the United States. Developing countries comprise Argentina, Brazil, Czech Republic, Chile, China, Colombia, Costa Rica, Guatemala, Honduras, Hungary, India, Indonesia, Israel, Jamaica, Korea, Malaysia, Mexico, Pakistan, Philippines, Poland, Singapore, Slovak Republic, South Africa, Thailandia, Tunisia, Turkey, Uruguay, and Venezuela. The data on private consumption, public consumption, and GDP for those countries are provided directly by World Bank's World Development Indicators (WBWDI). The data on international investment positions, and exports and imports have been obtained from the International Monetary Fund´s International Financial Statistics (IMFIFS). Additionally, as data on international investment positions are incomplete or missing for many countries (specially before 1980-1986), Lane and Milesi-Ferretti (2001, 2007)[22] provide an excellent source of data for those years[23]. Domestic holdings on foreign capital, K_d^*, is measured as direct plus portfolio equity investment by domestic agents abroad, while foreign holdings of domestic capital, K_f, refers to direct plus portfolio equity investment by foreign agents in the domestic economy. Total external assets and liabilities include the stock of direct plus portfolio equity, portfolio debt investment, other investment assets (general government, banks, and others), reserve assets (minus gold) and financial derivatives. The gross domestic capital stock in current US dollars for the countries in the sample is constructed using the procedure suggested by Kraay and Ventura (2000) in their Appendix 2[24]: gross domestic investment in current US dollars (from WBWDI) is cumulated assuming a depreciation rate of 4% per year, and adjusting the value of previous year's stock using the US gross domestic investment deflator. The initial capital stock in 1970 is estimated using the average capital-output ratio over the period 1965-1970[25] [based on Nehru and Dareshwar (1993)] multiplied by GDP in current US dollars (WBWDI). Domestic wealth, W, is constructed according to equation (1), and we also add the net foreign asset position of the country on empirical grounds.

First, we check the relationship between the different measures of financial openness. We show the relationship between magnitudes FO_1 and FO_2, then between FO_1 and FO_3, and finally between FO_2 and FO_3. We test the

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[22]From here onwards, we will refer only to Lane and Milesi-Ferretti (2007) for being the relevant data source for this paper.

[23]Please note that most of the data from IMFIFS, and from Lane and Milesi-Ferretti (2007) coincide for recent years.

[24]See also Erauskin (2009) for more details.

[25]The initial value for capital-output ratio for the world is the weighted mean of capital-output ratios in the sample of 22 countries for the period 1965-1970.

following regressions:

$$FO_{2,ct} = a_0 + a_1 FO_{1,ct} + u_{ct},$$
$$FO_{3,ct} = a_0 + a_1 FO_{1,ct} + u_{ct},$$
$$FO_{3,ct} = a_0 + a_1 FO_{2,ct} + u_{ct},$$

where $FO_{i,ct}$ denotes the degree of financial openness using Measure i for country c in period t, and u_{ct} is the error term for country c in period t. Under the null hypothesis that there is a positive relationship between both measures of financial openness then the coefficient a_1 should be positive. Table 1 shows the results: all the regressions exhibit a positive and significant relationship. This will allow later to test conveniently for robustness checks.

However, an additional important issue is how those measures are related to those suggested typically in the literature, such as those by Lane and Milesi-Ferretti (2007), for instance. In our model variables capturing the degree of financial openness are expressed in terms of wealth, while the literature on financial openness has usually been referred to GDP terms. To see the relationship between both ways of measuring financial openness we compare the most similar measures. First, we test the relationship between FO_2 (stock of direct and portfolio equity assets and liabilities, in terms of wealth), and $GEQY$ in Lane and Milesi-Ferretti´s paper (stock of direct and portfolio equity assets and liabilities, in terms of GDP). Then we test the relationship between FO_3 (stock of all external assets and liabilities, in terms of wealth) and $IFIGDP$ in their paper (stock of all external assets and liabilities, in terms of GDP):

$$FO_{2,ct} = a_0 + a_1 GEQY_{ct} + u_{ct},$$
$$FO_{3,ct} = a_0 + a_1 IFIGDP_{ct} + u_{ct},$$

where $FO_{i,ct}$ denotes the degree of financial openness using Measure i for country c in period t, $GEQY_{ct}$ refers to the stock of portfolio equity and direct investment assets and liabilities with respect to the GDP for country c in period t, $IFIGDP_{ct}$ is defined as the stock of external assets and liabilities with respect to the GDP for country c in period t, and u_{ct} is the error term for country c in period t. Under the null hypothesis that there is a positive relationship between both measures of financial openness then the coefficient a_1 should be positive. Positive and significant results are found again in Table 2.

Finally, we relate our measures of financial openness with the degree of trade openness, TO, understood typically as the sum of exports and imports

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in terms of GDP. We regress:

$$
\begin{aligned}
TO_{ct} &= a_0 + a_1 FO_{1,ct} + u_{ct}, \\
TO_{ct} &= a_0 + a_1 FO_{2,ct} + u_{ct}, \\
TO_{ct} &= a_0 + a_1 FO_{3,ct} + u_{ct},
\end{aligned}
$$

where $FO_{i,ct}$ is the degree of financial openness using Measure i for country c in period t, TO_{ct} is trade openness, defined as the ratio of exports and imports over GDP, for country c in period t, and u_{ct} is the error term for country c in period t. Under the null hypothesis of a positive relationship between financial openness and trade openness then the coefficient a_1 should be positive. We find again a positive and robust relationship in all cases, as shown in Table 3.

Summing up, the different measures chosen to capture the degree of financial openness in this paper seem to be positively related to the usual magnitudes of financial openness in the literature.

6 Empirical evidence

Four are the main results suggested by the model in Sections 3 and 4:

1. Financial openness is unambiguously positively related to the size of government.

2. Financial openness shows unambiguously a positive relationship with private consumption-wealth ratio.

3. The relationship between financial openness and the growth rate offers no clear-cut results. The result depends on the difference between productivities and the differences between consumption-wealth ratios among countries: for similar productivities, the growth rate would be lower in an open economy.

4. Public and private consumption are complementary to one another.

First, the model postulates a positive relationship between the size of the public sector (with respect to wealth) and financial openness. The positive association can be tested with the regression equation

$$
\left(\frac{G}{W} \right)_{ct} = a_0 + a_1 FO_{ct} + u_{ct}, \tag{43}
$$

where $(G/W)_{ct}$ denotes the size of the public sector-wealth ratio for country c in period t, FO_{ct} denotes the portfolio share of foreign capital in domestic wealth for country c in period t, and u_{ct} is the error term for country c in period t. Under the null hypothesis that a more open economy should have a higher size of the public sector is true then the coefficient a_1 should be positive. We estimate the regression equation (43) for the whole sample of 50 countries using ordinary least squares (OLS). To check the robustness of the result, we estimate the value of the coefficient a_1 for the 3 different measures of financial openness, such as FO_1, FO_2, and FO_3. As shown in Table 4, we find that all the point estimates for the parameter a_1 are positive in the pooled estimation. The null hypothesis that the value of the parameter a_1 is equal to zero can be comfortably rejected in all cases. Additionally, while the pooled estimation uses all the available variation in financial openness and public sector size by OLS, the between-group estimates (i.e., based on the mean values of the variables of the group) and the within-group estimates (also called fixed-effects estimators, i.e., in terms of deviations from the mean values of the variables of the group) offer more information about whether the pooling estimate is driven by persistent (the former case) or transitory (the latter case) differences in the degree of financial openness and the size of the public sector. Table 5 shows the results for the between and within estimates, as well as for the pooled. The between-group and within-group estimates for the coefficient capturing the impact of financial openness (FO_1) on the size of the public sector are found to be positive again, but the within estimate is not significant. Similar results are found for other measures of financial openness, such as FO_2, and FO_3(not shown).

Other variables may influence on the relationship as well. Thus some typical control variables have been incorporated to the regression equation. They include population and output per capita (both in levels and growth rates), so that the size of the economy, and also possible pressures on government spending are considered. Please note that the sum of exports and imports of goods and services (as a percentage of GDP) has also been incorporated as a control variable in order to capture the influence of trade openness on the size of the public sector. Now the period analyzed is restricted to 1975-2009 for the same set of countries due to data availability. We find that the inclusion of these variables influences slightly on the different estimates of the coefficient a_1, as shown in Table 6, but the strong positive relationship remains intact.

This is also true even if we estimate the equation only for industrial countries (22 countries), on the one hand, and for developing countries (28 countries), on the other. Table 7 captures the results for the first measure and for the pooled estimation. The figures offered by the empirical evid-

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ence exhibit somewhat different results in industrial countries with respect to developing countries, but in both cases the null cannot be rejected.

Second, the result that consumption-wealth ratio is higher in an open economy than in a closed economy can be tested with the regression equation

$$\left(\frac{C}{W}\right)_{ct} = a_0 + a_1 FO_{ct} + u_{ct},$$

where $(C/W)_{ct}$ denotes consumption-wealth ratio for country c in period t. Again under the null hypothesis that more open economies should have higher consumption-wealth ratios is true then the parameter a_1 should be positive. We show in Table 8 the results of fitting the regression equation by OLS for the 3 different measures of financial openness for the pooled estimation. Results are very clear: the relationship is strongly positive. However, when we check for the robustness of the relationship providing other estimates we find puzzling results. Table 9 shows between and within estimates: while the between estimate increases notably, the within estimate becomes negative (but not significant). To see why this can be we plot in Figure 1 the data for the between regression. In the most northeastern area of Figure 1, and completely apart, lies Singapore. Removing Singapore from the sample, results do change completely. Table 10 shows how all the coefficients now turn negative[26]. This may reject the predictions of the model for the consumption-wealth ratio, but if we add control variables to the regression, as exhibited in Table 11, results change again substantially: there exists a positive and robust relationship between financial openness and consumption-wealth ratio. Moreover, if we remove Singapore from the sample when control variables are included, results change only very slightly. Similar results can be extended to the rest of magnitudes for financial openness (not shown). If we consider the relationship for industrial countries and developing countries then we get different results especially for developing countries (even if we remove Singapore), as shown in Table 12.

Third, the model offers no clear-cut results for the theoretical relationship between financial openness and the growth rate of wealth, as shown in equation (29). The relationship between the degree of financial openness and the growth rate can be tested with the regression equation

$$\left(\frac{dW}{W}\right)_{ct} = a_0 + a_1 FO_{ct} + u_{ct}.$$

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[26]This result may wonder whether the positive relationship between the size of government and financial openness may change. They change very slightly, so we will not pursue that further.

where $(dW/W)_{ct}$ denotes the growth rate of wealth for country c in period t. Under the null hypothesis that more open economies should have higher growth rates of wealth is true the parameter a_1 should be positive. In fact, we find that the estimate a_1 is positive and significant for the three different measures, as shown in Table 13, regardless of whether Singapore is included or not. Figures are more modest when we remove Singapore. This suggests that Singapore drives most of the results. Thus from here onwards we will discard Singapore for most of our analysis. Table 14 confirms the positive relationship for the between and within estimates. The positive relationship is also found when control variables are included for the pooled data (see Table 15). Table 16 shows also that the result is robust for industrial and developing countries.

However, it seems paradoxical that both the growth rate of wealth and consumption-wealth ratio are higher in open economies than in closed economies as higher consumption-wealth ratios seem likely to be associated to lower growth rates. In fact, that would be the case if productivities were equal, as seen in equation (29). How can growth rates be higher in open economies then? To have an answer we have to look at the term $n_d^*(\alpha^* - \alpha)$, which reflects the difference between foreign and domestic productivity weighted by the degree of financial openness. This term should be positive. We use the growth rate of world GDP per capita and domestic GDP per capita as a proxy for, respectively, foreign productivity, α^*, and domestic productivity, α. The proper weights are calculated using measure 1 of financial openness, FO_1. Then we can test the impact of financial openness on the term $n_d^*(\alpha^* - \alpha)$ through the regression equation

$$[n_d^*(\alpha^* - \alpha)]_{ct} = a_0 + a_1 FO_{1,ct} + u_{ct}.$$

Under the null hypothesis that financial openness is positively related to the term $n_d^*(\alpha^* - \alpha)$, then the coefficient a_1 should be positive. We show the results for this regression in Table 17, including or not Singapore, and including or not control variables. First, even though the term is negative without control variables, it becomes positive when controls are included. Second, we see that, removing Singapore from the sample, the term is positive with or without control variables, as expected, but the results are not significant. However, this evidence suggests how apparently contradictory results can be reconciled.

Fourth, both private and public consumption are complementary to one another in this model. This can be tested with the regression equation

$$\left(\frac{G}{W}\right)_{ct} = a_0 + a_1 \left(\frac{C}{W}\right)_{ct} + u_{ct},$$

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where $(G/W)_{ct}$ denotes the size of the public sector-wealth ratio for country c in period t. Under the null hypothesis that both private and public consumption are complements the coefficient a_1 should be positive. Table 18 shows the results: estimates for a_1 in the regression are clearly positive in all cases, pooled, between and within. Similar results are found when control variables are included [see Table 19]. These results provide additional support to those of Ganelli and Tervala (2009), who also find a positive relationship between private and public consumption.

Summing up, the empirical evidence for 50 countries in the recent period 1970-2009 broadly supports the four main theoretical results of the model. However, it should be noted that the inclusion of Singapore distorts sometimes this broad picture.

7   Conclusions

This paper has analyzed the impact of financial openness on the size of government and other key economic variables, such as the consumption-wealth ratio, the growth rate of wealth, and welfare, in a two-country world, based on a portfolio approach, assuming that public spending is utility-enhancing. The theoretical model suggest that both the size of government and consumption-wealth ratio should be higher in an open economy than in a closed economy. Financial openness allows a wider choice of portfolios: it may lead to higher productivity and/or less volatility through a higher diversification of the country-specific risk. This implies a reduction in savings and an increase in private consumption: consumption-wealth ratio is higher in an open economy than in a closed economy. Given that public and private consumption are complements, the size of the public sector is also higher in an open economy than in a closed economy. This is true for welfare as well. The theoretical results for the growth rate are more ambiguous, as they depend on differences in productivities, and differences in consumption-wealth ratios among countries.

The empirical evidence confirms that a financially more open economy is associated to a higher size of government and consumption-wealth ratio. And this result is robust across different specifications, even though the results for Singapore distort sometimes the broad picture. When we turn to the growth rate, the empirical evidence suggests that more open economies are associated to higher growth rates. This is somewhat paradoxical as we would expect just the opposite for similar productivities. However, more open economies have been found to achieve higher rates of return of the portfolio thus explaining why consumption-wealth ratio should be higher in an open eco-

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nomy than in a closed economy. Additionally, government consumption and private consumption have been shown to be complementary. Therefore, the empirical evidence based on a sample of 50 countries for the period 1970-2009 broadly supports the main results of the model, even though the inclusion of Singapore distorts sometimes the broad picture.

A   Optimization

The first step in order to solve the optimization problem in the domestic economy is to introduce a value function, $V(W)$, which is defined as

$$V(W) = \underset{\{C,n_d\}}{Max} E_0 \int_0^\infty \frac{1}{\gamma}(CG^\eta)^\gamma e^{-\beta t}dt, \qquad (44)$$

subject to restrictions (10), (11), and (12) and given initial wealth. The value function in period 0 is the expected value of the discounted sum of instantaneous utilities, evaluated along the optimal path, starting in period 0 in the state $W(0) = W_0$.

Second, starting from equation (44) the value function must satisfy the following equation, known as the Hamilton-Jacobi-Bellman equation of stochastic control theory or, for short, the Bellman equation

$$\beta V(W) = \underset{\{C,n_d\}}{Max} \left[\frac{1}{\gamma}(CG^\eta)^\gamma + V'(W)W\psi + 0.5V''(W)W^2\sigma_w^2\right]. \qquad (45)$$

Third, (45) is partially differentiated with respect to C and n_d in order to get the first order optimality conditions of this problem

$$C^{\gamma-1}G^{\eta\gamma} - V'(W) = 0 \qquad (46)$$
$$V'(W)W\left(\alpha - \alpha^*\right) + V''(W)W^2 cov\left[dw, \alpha dy - \alpha^* dy^*\right] = 0. \qquad (47)$$

The solution to this maximization problem is obtained through trial and error. We seek to find a value function $V(W)$ that satisfies, on the one hand, the first order optimality conditions and, on the other, the Bellman equation. In the case of isoelastic utility functions the value function has the same form of the utility function [Merton (1969), generalized in Merton (1971)]. Thus, we guess that the value function is of the form

$$V(W) = AW^{\gamma(1+\eta)}, \qquad (48)$$

where the coefficient A is determined below. That guess implies

$$
\begin{aligned}
V'(W) &= A\gamma(1+\eta)W^{\gamma(1+\eta)-1} \\
V''(W) &= A\gamma(1+\eta)\left[\gamma(1+\eta) - 1\right]W^{\gamma(1+\eta)-2}.
\end{aligned}
$$

Inserting these expressions into the first order optimality conditions (46) and (47), the result is

$$C^{\gamma-1}G^{\eta\gamma} = A\gamma(1+\eta)W^{\gamma(1+\eta)-1} \tag{49}$$

$$(\alpha - \alpha^*)\,dt = [1 - \gamma(1+\eta)]\,cov\,[dw, \alpha dy - \alpha^* dy^*]. \tag{50}$$

Both are typical equations in stochastic models in continuous time. Equation (49) indicates that at the optimum, the marginal utility derived from private consumption must be equal to the marginal change in the value function or the marginal utility of wealth. Equation (50) shows that the optimal choice of portfolio shares must be such that the risk-adjusted rates of return of both domestic and foreign capital are equalized.

Combining (49) and (50), and substituting them in the equation (45), we are able to calculate, after some algebra, the equilibrium portfolio shares and the consumption-wealth ratio in the domestic open economy, shown in equations (13), (14), and (15),

$$n_d = \frac{\alpha - \alpha^*}{[1 - \gamma(1+\eta)]\,\Delta} + \frac{\alpha^{*2}\sigma_{y^*}^2 - \alpha\alpha^*\sigma_{yy^*} + \alpha\sigma_{yz} - \alpha^*\sigma_{y^*z}}{\Delta}$$

$$n_d^* = 1 - n_d$$

$$\left(\frac{C}{W}\right)_o = \frac{1}{(1-\gamma)(1+\eta)}\left[\beta - \gamma(1+\eta)\left(\rho - g\right)\right.$$
$$\left. + 0.5\gamma(1+\eta)[1 - \gamma(1+\eta)]\sigma_{w,o}^2\right],$$

where

$$\Delta = \alpha^2\sigma_y^2 - 2\alpha\alpha^*\sigma_{yy^*} + \alpha^{*2}\sigma_{y^*}^2$$

$$\sigma_{w,o}^2 = n_d^2\alpha^2\sigma_y^2 + 2n_d n_d^*\alpha\alpha^*\sigma_{yy^*} + n_d^{*2}\alpha^{*2}\sigma_{y^*}^2 + \sigma_z^2$$
$$- 2n_d\alpha\sigma_{yz} - 2n_d^*\alpha^*\sigma_{y^*z},$$

as they are shown in equations (16) and (17).

B Second order conditions

In order to guarantee that consumption is positive in the domestic open economy we impose the feasibility condition that the marginal propensity to consume out of wealth [see equation (15)] must be positive since wealth does not become negative

$$
\frac{1}{(1-\gamma)(1+\eta)}\left\{\beta - \gamma(1+\eta)\left(\rho - g\right)\right.
$$
$$
\left. +0.5\gamma(1+\eta)[1-\gamma(1+\eta)]\sigma^2_{w,o}\right\} > 0.
$$

For the first order optimality conditions to characterize a maximum, the corresponding second order condition must be satisfied, that is, the Hessian matrix associated to the maximization problem and evaluated at the optimal values of the choice variables

$$
\begin{bmatrix} (\gamma - 1)\left(V'(W)\right)^{\frac{\gamma-2}{\gamma-1}} & 0 \\ 0 & V''(W)W^2\Delta \end{bmatrix}
$$

must be negative definite,[27] which implies that

$$
\begin{aligned}
(\gamma - 1)\left(V'(W)\right)^{\frac{\gamma-2}{\gamma-1}} &< 0 \\
V''(W)W^2\Delta &< 0,
\end{aligned}
$$

where $\Delta > 0$ (in a risky economy) was already defined in equation (16). To evaluate those conditions, first we obtain the value of the coefficient A in equation (49)

$$
A = \frac{g^{\eta\gamma}}{\gamma(1+\eta)}\left(\frac{C}{W}\right)^{\gamma-1}, \tag{51}
$$

where C/W is the optimal value pointed out by equation (15). Then we insert (51) into the value function (48). Noting that $g = G/W$, the value function is given, after some algebra, by

$$
V(W) = \frac{g^{\eta\gamma}}{\gamma(1+\eta)}\left(\frac{C}{W}\right)^{\gamma-1}W^{\gamma(1+\eta)}, \tag{52}
$$

---

[27]See Chiang (1984, pp. 320-323), for example.

where we can observe that, given the restrictions on the utility function, $V'(W) > 0$ and $V''(W) < 0$ provided that $C/W > 0$.

In addition, we impose that the macroeconomic equilibrium must satisfy the transversality condition so as to guarantee the convergence of the value function

$$\lim_{t \to \infty} E\left[V(W)e^{-\beta t}\right] = 0. \tag{53}$$

Now let us show that should the feasibility condition be satisfied, that would be equivalent to satisfy the transversality condition.[28] To evaluate (53), we start expressing the dynamics of the accumulation of wealth

$$dW = \psi W dt + W dw. \tag{54}$$

The solution to equation (54), starting from the initial wealth $W(0)$, is[29]

$$W(t) = W(0)e^{(\psi - 0.5\sigma_w^2)t + w(t) - w(0)}.$$

Since the increments of w are temporally independent and are normally distributed then[30]

$$
\begin{aligned}
E[AW^{\gamma(1+\eta)}e^{-\beta t}] &= E[AW(0)^{\gamma(1+\eta)}e^{\gamma(1+\eta)(\psi - 0.5\sigma_w^2)t + \gamma(1+\eta)[w(t) - w(0)] - \beta t}] \\
&= AW(0)^{\gamma(1+\eta)}e^{\left[\gamma(1+\eta)(\psi - 0.5\sigma_w^2) + 0.5\gamma^2(1+\eta)^2\sigma_w^2 - \beta\right]t}.
\end{aligned}
$$

The transversality condition (53) will be satisfied if and only if

$$\gamma(1+\eta)\left\{\psi - 0.5\gamma(1+\eta)\left[1 - \gamma(1+\eta)\right]\sigma_w^2\right\} - \beta < 0.$$

Now substituting equations (11) and (15), it can be shown that this condition is equivalent to

$$\frac{C}{W} > 0,$$

and thus feasibility guarantees convergence as well.

Finally, it should be noted that since the public sector equilibrates its budget continuously, the intertemporal budget constraint of the public sector is satisfied trivially.

---

[28]See Merton (1969). Turnovsky (2000) provides, for example, the proof of the transversality condition as well.

[29]See Malliaris and Brock (1982, pp. 135-136), for example.

[30]See Malliaris and Brock (1982, pp. 137-138), for example.

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Table 1: Relationship between different measures of financial openness. Pooled estimation

Regressand:	FO_2	FO_3	FO_3
Regressor:	FO_1	FO_1	FO_2
Estimate of a_1	2.2176***	5.7747***	2.6118***
	(.0860)	(.3745)	(.1024)
R^2	0.8838	0.8034	0.91448
No. of observations	1.748	1.748	1.748

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 2: Relationship between different measures of financial openness. Wealth vs. GDP. Pooled estimation

Regressand:	FO_2	FO_3
Regressor:	$GEQY$	$IFIGDP$
Estimate of a_1	.4769***	.5919***
	(.0328)	(.0378)
R^2	0.6865	0.6825
No. of observations	1.748	1.748

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 3: Relationship between financial openness and trade openness. Regressor: Trade openness. Pooled estimation

Regressand:	FO_1	FO_2	FO_3
Estimate of a_1	.2368***	.6003***	1.5068***
	(.0169)	(.0364)	(.1005)
R^2	0.3487	0.4035	0.3403
No. of observations	1.640	1.640	1.640

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and

Dareshwar (1993), and own elaboration.

Table 4: Financial openness (different measures) and the size of the public sector. Pooled estimation

	FO_1	FO_2	FO_3
Estimate of a_1	.0474***	.0271***	.0106***
	(.0072)	(.0043)	(.0019)
R^2	0.0830	0.1506	0.1785
No. of observations	1.732	1.732	1.732

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 5: Financial openness (FO1) and the size of the public sector: Pooled, between, and within estimates

	Pooled regression	Between regression	Within regression
Estimate of a_1	.0474***	.0947***	.0135
	(.0072)	(.0228)	(.0189)
R^2	0.0830	0.2646	0.0079
No. of observations	1.732	50	1.732

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 6: Financial openness (different measures) and the size of the public sector (with control variables)

	FO_1	FO_2	FO_3
Estimate of a_1	.0268***	.0252***	.0098***
	(.0084)	(.0059)	(.0024)
Time trend	-.0001	-.0003	-.0002
	(.0001)	(.0001)	(.0001)
Trade openness	.0110	.0029	.0031
	(.0041)	(.0041)	(.0038)
Population	-2.48e-11	-2.53e-11	-2.48e-11
	(2.75e-12)	(2.67e-12)	(2.53e-12)
Population growth	-.0028	-.0038	-.0036
	(.0015)	(.0016)	(.0015)
GDP per capita	1.52e-07	4.94e-08	2.46e-08
	(1.30e-07)	(1.45e-07)	(1.41e-07)
GDP per capita growth	.0005	.0005	.0005
	(.0003)	(.0003)	(.0003)
R^2	0.1407	0.1938	0.2172
No. of observations	1.628	1.628	1.628

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 7: Financial openness (FO1) and the size of the public sector: industrial and developing countries. Pooled estimation

	All countries	Industrial countries	Developing countries
Estimate of a_1	.0474***	.0346***	.0597***
	(.0072)	(.0059)	(.0157)
R^2	0.0830	0.0878	0.0787
No. of observations	1.732	877	855

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 8: Financial openness and consumption-wealth ratio: three different measures. Pooled estimates

	$FO1$	$FO2$	$FO3$
Estimate of a_1	.0769**	.0895***	.0353***
	(.0303)	(.0210)	(.0086)
R^2	0.0119	0.0903	0.1077
No. of observations	1.733	1.733	1.733

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

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Table 9: Financial openness (FO1) and consumption-wealth ratio: pooled, between, and within estimates

	Pooled regression	Between regression	Within regression
Estimate of a_1	.0769**	.2485**	-.0423
	(.0303)	(.1018)	(..0891)
R^2	0.0119	0.1105	0.0119
No. of observations	1.733	50	1.733

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 10: Financial openness (FO1) and consumption-wealth ratio: pooled, between, and within estimates when Singapore is removed

	Pooled regression	Between regression	Within regression
Estimate of a_1	-.0273	-.2912**	-.0571
	(.0245)	(.1289)	(.0450)
R^2	0.0015	0.0980	0.0078
No. of observations	1.699	49	1.699

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 11: Financial openness (different measures) and consumption-wealth ratio (with control variables)

	FO_1		FO_2	FO_3
	With	Without	With	With
Estimate of a_1	.1252***	.1335***	.1304***	.0481***
	(.0351)	(.0218)	(.0332)	(.0128)
Time trend	.0007	.0028	-.0001	.0002
	(.0004)	(.0003)	(.0005)	(.0005)
Trade openness	.0314	-.1073	-.0128	-.0085
	(.0223)	(.0085)	(.0236)	(.0208)
Population	-1.14e-10	-1.74e-10	-1.18e-10	-1.14e-10
	(1.54e-11)	(1.05e-11)	(1.47e-11)	(1.40e-11)
Population growth	.0128	.0053	.0070	.0083
	(.0052)	(.0039)	(.0058)	(.0054)
GDP per capita	-5.36e-06	-5.58e-06	-6.02e-06	-6.04e-06
	(4.83e-07)	(4.24e-07)	(6.53e-07)	(6.35e-07)
GDP per capita growth	.0042	.0036	.0043	.0045
	(.0011)	(.0010)	(.0011)	(.0011)
R^2	0.1949	0.2631	0.2766	0.2977
No. of observations	1.629	1.597	1.629	1629

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 12: Financial openness (FO1) and the consumption-wealth ratio: Industrial and developing countries

	All countries	Industrial countries	Developing countries
Estimate of a_1	.0769**	.0285*	.2336***
	(.0303)	(.0163)	(.0711)
R^2	0.0119	0.0076	0.0606
No. of observations	1.733	877	856

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 13: Financial openness (FO1) and the growth rate: Different measures

	FO_1		FO_2		FO_3	
	With	Without	With	Without	With	Without
Estimate of a_1	.1730***	.0332***	.0972***	.0210***	.0343***	.0060***
	(.0327)	(.0075)	(.0192)	(.0032)	(.0079)	(.0010)
R^2	0.1584	0.0214	0.2796	0.0475	0.2667	.0318
No. of observations	1.745	1.711	1.745	1.711	1.745	1.711

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and

Dareshwar (1993), and own elaboration.

Table 14: Financial openness (FO1) and the growth rate: Pooled, between, and within estimate

	Pooled regression	Between regression	Within regression
Estimate of a_1	.0332***	.0603***	.0177
	(.0075)	(.0083)	(.0109)
R^2	0.0214	0.5266	0.1072
No. of observations	1.711	50	1.745

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 15: Financial openness and growth rate (with control variables) for the pooled estimation

	FO_1	FO_2	FO_3
Estimate of a_1	.0591***	.0292***	.0078***
	(.0075)	(.0037)	(.0010)
Time trend	-.00002	-.0001	.00002
	(.00001)	(.0001)	(.0001)
Trade openness	.0074	.0041	.0076
	(.0033)	(.0032)	(.0032)
Population	5.43e-12	7.02e-12	7.65e-12
	(4.41e-12)	(4.38e-12)	(4.32e-12)
Population growth	-.0004	-.0003	.0001
	(.0013)	(.0013)	(.0013)
GDP per capita	-7.38e-07	-6.04e-07	-5.26e-07
	(1.07e-07)	(1.18e-07)	(1.09e-07)
GDP per capita growth	.0035	.0035	.0035
	(.0003)	(.0003)	(.0003)
R^2	0.1854	0.2085	0.1848
No. of observations	1.598	1.598	1.598

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 16: Financial openness (FO1) and the growth rate: Industrial and developing countries

	All countries	Industrial countries	Developing countries
Estimate of a_1	.0332***	.0421***	.0851***
	(.0075)	(.0072)	(.0182)
R^2	0.0214	0.0959	0.0158
No. of observations	1.711	877	834

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 17: The impact of financial openness on productivity (with or without control variables)

	With Singapore		Without Singapore	
	Without controls	Without controls	With controls	With controls
Estimate of a_1	-.5388	.6709	.3658	1.0640
	(.6588)	(.7093)	(.8893)	(.900)
Time trend			.0037	-.0033
			(.0031)	(.0034)
Trade openness			-.5511	-.1656
			(.1815)	(.0687)
Population			-2.83e-12	1.10e-10
			(8.86e-11)	(3.64e-11)
Population growth			-.0785	-.0648
			(.0544)	(.0283
GDP per capita			-9.32e-06	-.00001
			(7.54e-06)	(6.28e-06)
GDP per capita growth			-.0690	-.0458
			(.0109)	(.0071)
R^2	0.0194	.0479	0.2019	0.1598
No. of observations	1714	1680	1623	1590

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 18: The complementarity between private and public consumption

	Pooled regression	Between regression	Within regression
Estimate of a_1	.1402***	.0701**	.1872***
	(.0072)	(.0340)	(.0105)
R^2	0.3585	0.0813	0.7120
No. of observations	1.732	50	1.732

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Table 19: The complementarity between private and public consumption (with control variables)

|	Pooled regression	Between regression	Within regression
Estimate of a_1	.1638***	.0861**	.1881***
	(.0056)	(.0372)	(.0129)
Time trend	-.0002		.0004
	(.0001)		(.0002)
Trade openness	.0071	.0117	-.0120
	(.0016)	(.0076)	(.0059)
Population	-5.57e-12	-2.31e-11	3.26e-11
	(2.49e-12)	(2.15e-11)	(1.73e-11)
Population growth	-.0046	-.0045	.0002
	(.0011)	(.0046)	(.0014)
GDP per capita	1.09e-06	8.36e-07	-2.00e-07
	(8.93e-08)	(4.03e-07)	(4.97e-07)
GDP per capita growth	-.0002	.0027	-.0005
	(.0002)	(.0030)	(.0001)
R^2	0.5254	0.4008	0.7581
No. of observations	1.628	50	1.628

Standard errors are in parenthesis.

*: Significant at 10% level; **: Significant at 5% level; ***: Significant at 1% level.

Sources: IMFIFS, WBWDI, Lane and Milesi-Ferretti (2007), Nehru and Dareshwar (1993), and own elaboration.

Figure 1: Consumption-wealth ratio (C/W) and the degree of financial open-ness (FO1).
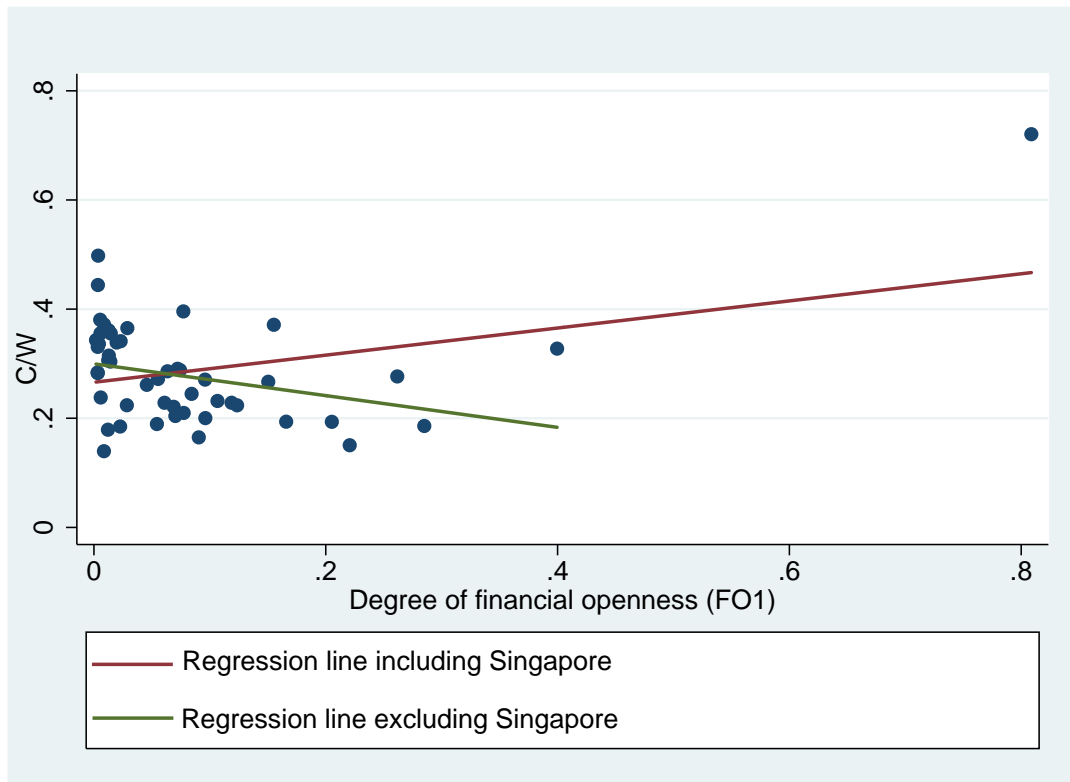
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