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Privatization, International Asset Trade and Financial Markets

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Summary

This paper evaluates the impact of privatization on the development of capital markets in a two-country general equilibrium model. We draw particular attention to two divestment techniques, share issue privatizations (in developed market systems) and voucher privatizations (in transition economies). It is shown how these two privatization methods can have an impact, by diversification effects, on supplies of private assets, demands for assets, market capitalizations and international asset allocation strategies. We show that even a non-marketed privatization (free distribution of public assets to private individuals) has market-effects, by altering portfolio choices.

Keywords: Financial integration; International risk-sharing; Share issue privatization; Stock market de-velopment; Voucher privatization

JEL: F3, G1, L33

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1 Introduction

The stylized facts presented in Verdier and Winograd [1998] teach that the common way to implement the transfer of assets from the public sector to the private sector was in several eastern economies free distribution of public assets to private individuals. This divestment method has been only used in transition economies where there was neither preexisting private sector nor preexisting financial markets. In these economies, voucher privatization has brought about fundamental changes in the ownership of business assets. However, from a theoretical viewpoint, in a symmetric closed economy (where free shares of the privatized assets are uniformly distributed among agents), Bosi, Girmens, and Guillard [2001] show that voucher privatization has real effects but is financially neutral, as the new stocks issued are not exchanged at equilibrium. Privatization by free distribution of public assets may have an impact on financial markets, because of risk-sharing issues, if and only if distributed shares are exchanged at equilibrium, i.e. as soon as there is some heterogeneity among initial shareholders. A way to introduce heterogeneity is to consider an open-economy setup, with voucher distribution only to domestic agents. Foreign agents will be interested in this new diversification opportunity as soon as new stocks are imperfectly correlated with existing ones. Thus, even though public assets are not directly sold on the financial market, privatization has financial effects.

Besides, in the stylized economy presented by Bosi, Girmens, and Guillard [2001], individuals would like to smooth consumption of two types of good (private and public) across different states of nature. Public good provision is assumed to be initially not diversified across these states of nature. An efficient tax system removes this problem, always ensuring public good financing. Without efficient taxation, it is shown that an optimal privatization mix includes some share issue privatization (SIP)[1], whose revenues are invested in a diversified portfolio of private assets, in order to smooth public good provision across

[1] One of the four principal divestment methods presented by Brada [1996] is *Privatization Through Sale of State Property.* According to Megginson and Netter [2001], this category takes two important forms. The first is *direct sales* of state-owned enterprises to an individual, an existing corporation, or a group of investors. The second form is *share issue privatizations* (SIPs), in which some or all of a government's stake in a state-owned enterprise is sold to investors through a public share offering.

states of nature. The investment of privatization revenues in a diversified portfolio of private assets seems to be unrealistic in transition economies, but not at all in developed market systems. For instance in France, revenues from the privatization of the saving banks, as well as from the sale of licenses for UMTS mobile phone (interpreted as a waves privatization), are directed to a retirement reserve funds. The debate is still open, but the government recognizes that the need of better returns diverts these funds towards the stock market. Similarly, the United States and Canada are equipped with such a retirement reserve funds, and consider that it should be partly invested on the stock exchange.

Thanks to a two-country general equilibrium model, this paper focuses on the impact of privatization on the development of capital markets, especially on the financial effects of the two alternative privatization methods described above:

- voucher privatization (more precisely: distribution of free shares of the privatized assets), in the case of transition economies;
- SIP and purchase of a diversified portfolio by the government, in the case of developed market systems.

Of course, most governments actually use SIPs without letting market mechanisms determine the price of the privatized asset. They underprice share offerings and then use targeted share allocations to favor domestic over foreign investors. Similarly, in the case of voucher privatization, domestic agents do not always receive free shares of the privatized assets. More generally, according to Brada [1996]'s taxonomy of privatization methods, in a voucher privatization program, eligible citizens can utilize vouchers, distributed free or at a nominal cost, to bid for shares of state-owned enterprises and of other assets that are being privatized.[2] But the analysis of our two polar cases (distribution of free shares and pure SIP) helps to understand what happens in intermediary situations.

Our approach is related to the financial and macro-economic literature on incomplete asset markets and risk-sharing as well as to the literature on asset trade under uncertainty, in particular and among many others to the papers of Martin and Rey [2000] and Pagano [1993]. However, and although the literature

[2] For details on the Czech voucher privatization for instance, see Filer and Hanousek [2001].

on privatization is rapidly growing[3], this is an original approach to privatization for at least two reasons. First, even if some recent works have suggested this idea of privatization as a way of allocating risks across members of the economy (Maskin [2000], Perotti and van Oijen [2001]), privatization has been rarely analyzed in a general equilibrium setup. Second, voucher privatization is often thought to have less interest than SIPs in terms of financial effects.

The basic idea of this paper is that privatization increases risk sharing opportunities for risk averse agents. We show how this new diversification possibility in turn encourages an increase in private asset supplies. This is consistent with the seminal work of Pagano [1993]. But in contrast to this article, there are no multiple equilibria due to coordination failures in our model, because privatization is taken as given, as exogenous, by private agents. Among other results, our open-economy model, based on diversification effects, helps to understand secondary market activity after voucher privatization, and, more generally, portfolio reallocations due to privatization, even in the case of "marginal" privatizations in developed market systems.

The rest of the paper is organized as follows. Section 2 presents the theoretical framework. Section 3 analyzes the financial effects of voucher privatization (in transition economies). Section 4 investigates the properties of the model with SIP (in developed market systems). Last section concludes.

2 A theoretical model

This two-period general equilibrium open-economy model is inspired by Martin and Rey [2000]. Consider two countries, A and B. There are n_A identical immobile private agents (indexed by $i = 1, \ldots, n_A$) in country A and n_B private agents in country B (indexed by $k = n_A + 1, \ldots, n_A + n_B$). They interact with the government of country A (indexed by $g = n_A + n_B + 1$). In the second period, there are S exogenously determined and equally likely states of nature indexed by $s \in \{1, \ldots, S\}$, revealed at the beginning of the period.

[3] For recent surveys, see Roland [2000] and Megginson and Netter [2001].

2.1 Endowments and technology

In the more general setup, we will assume that, in the first period, each agent (including country A government) have a property right over a second-period stochastic endowment in private good. More precisely the endowment of agent z is equal to:

$$e_z(s) = \begin{cases} 1 \text{ if } s = z \\ \\ 0 \text{ otherwise} \end{cases} \tag{1}$$

The property right in the first period can be interpreted as a firm, or as a specific risky project, which provides a return of 1 in a specific state of nature and of 0 otherwise. In this respect there is a complete specialization and no technological diversification at all. This property right can also be interpreted as an Arrow-Debreu security that pays only in one state of nature. The assumption may look quite extreme[4]; however, what is crucial here is not this identity between projects and states of nature, but that the different projects are imperfectly correlated and that there are risk-sharing opportunities for risk-averse agents. We could envisage to replace the relation "one project - one state of nature" by n linearly independent payoff vectors (one for each agent), each individual project giving different returns in different states of nature. This would complicate the analytical solution of the model, without changing the qualitative results.

Without taxes, the only resource the government has at disposal is this stochastic endowment. This endowment in private good is used as input and converted in public good by a specific technology in the second period. By simplicity we consider an identity production function which transforms one unit of private good in one unit of public good.[5]

[4] Acemoglu and Zilibotti [1997] and Martin and Rey [2000] have a similar assumption of contingent projects.

[5] In a recent paper on privatization, Huizinga and Nielsen [2001] also consider that the public good is a one-to-one transformation of the single produced good.

2.2 Preferences

There are two types of goods in country A (private and public) and only private consumption in country B:

$$\begin{aligned} U_A(c_i, G) &= u(c_i) + v(G) \\ U_B(c_k) &= u(c_k) \end{aligned}$$

Sub-utility functions u and v are specified as follows:

$$u(c) = c^\rho;\ v(G) = G^\rho$$

where

$$0 < \rho < 1$$

This specification allows for straightforward computations, but result generality is preserved as well as the main kind of transmission mechanism between privatization and financial indicators.

2.3 Financial markets

Shares of the property rights (claims on the stochastic endowments) can be traded on financial markets during the first period (this is the only economic activity during this period). p_z is the price of the asset issued by the agent z. $d_{zz'}$ is the demand of the agent z for assets issued by the agent z'. Agents do not cross-list firms: their assets are not quoted on foreign markets.[6] They simply rely on market integration to sell assets to foreign investors.

2.4 Privatization

The government privatizes a share σ of its initial property right, treated as an exogenous variable: the privatization extent is not decided by the short run policy maker but exogenously fixed by an independent power such as a parliament, or by a prior electoral program of government's coalition; it belongs to a long-run strategy: by assumption the government is forced to distribute (voucher privatization) or to sell

[6] Suppose for instance that there is an arbitrarily small cost to list abroad.

(SIP) a given amount σ. Consistently with empirical observations[7], the public initial property right is therefore not necessarily completely privatized: σ is a continuous variable, $0 < \sigma \leq 1$.

2.5 Stock market size and other stock market development indicators

Market capitalization (equals the value of listed shares) is frequently used as a measure of stock market size. In our model, it is defined as follows:

$$\begin{aligned} C_A &\equiv \left(\sum_{i=1}^{n_A} p_i (1 - d_{ii}) \right) + p_g \sigma \\ C_B &\equiv \sum_{k=n_A+1}^{n_A+n_B} p_k (1 - d_{kk}) \end{aligned}$$

Looking at the expressions of market capitalization in both countries, there is an obvious difference, as two types of assets are quoted on the market A, whereas there is only one type of asset quoted in country B. Consequently, there will be at least a positive direct effect of privatization on market capitalization in the country A, as soon as the new stocks issued are exchanged. This effect may be very strong if σ is close to one and if at the same time, the public sector initially represents a large share of the economy (if its weight in the initial property rights, equal to $1/(n_A + 1)$ is sufficiently large). Empirically, this direct weight of privatization on domestic market capitalization is indeed likely to be strong: Megginson and Netter [2001] notice that privatized firms are one of the two or three most valuable companies in most non-US markets, and that the 10 largest (and 30 of the 35 largest) share issues in financial history have all been privatizations.

For country A, we define also the *private* market capitalization C'_A, excluding privatized assets, thus referring only to preexisting assets:

$$C'_A \equiv C_A - p_g \sigma$$

It is admitted that *liquidity* is a complement to measures of stock market size. Among others, two measures of liquidity are the total value traded and the turnover ratio. Although we could theoretically

[7] For instance, French Government still appears among the top shareholders for some of the privatized firms quoted on the Paris stock exchange: it holds directly 55.90% of Air France, 55.50% of France Telecom, 44.22% of Renault, 16.30% of Bull, 9.60% of Crédit Lyonnais, etc.

compute them, they are not actually relevant in our setup, in which there are no dynamic behaviors on financial markets. Finally, it is interesting to gauge whether markets price risk efficiently, i.e. to see if comparable assets (same risk, same expected return) have the same price. We guess already that in our setup, as there is no exogenous trading costs, no imperfections, assets with the same fundamentals keep the same price.

3 Distribution of free shares in transition economies

We focus on voucher privatization. The government freely distributes shares of its property right. This distribution occurs *ex ante*, i.e. before financial markets open. Each one of the n_A domestic private agents gets $1/n_A$ of the stocks issued. Only domestic agents get shares of the privatized project: this introduces some asymmetry between domestic and foreign agents in the model; this is a way to introduce heterogeneity. Agents can trade shares of this additional property right on the domestic financial market. As privatization consists in a free distribution, there will be no privatization revenue (and in consequence no government budget constraint), and public good production occurs only in state $g = n_A + n_B + 1$. In this state of nature, public good production is simply equal to $1 - \sigma$. Obviously, this is not an optimal policy in terms of public good provision diversification and thereby in terms of welfare.[8] However, we take this policy as given, and focus on financial effects.[9]

In our simple two-period setup, we do not assume that private agents are obliged to keep the free shares they get during a given lapse of time. They can exchange them immediately on financial markets, i.e. a secondary market immediately develops. This is a necessary condition to get financial effects in this two-period model. If somehow or other the securities issued by the government are not exchanged during the first period, there are no financial effects at all, as in the closed-economy case, where free shares of the privatized assets are uniformly distributed among agents.

[8] Empirically, Megginson and Netter [2001] actually confirm that voucher privatization is the least economically productive divestment method, but add that the governments that use it generally have few other realistic options.

[9] For optimal privatization designs and an analysis in terms of real effects in a closed-economy setup, see Bosi, Girmens, and Guillard [2001].

Historically, this divestment method has been only used in transition economies where there was neither private sector nor financial markets. As a consequence, we will assume in this section that there is initially no property rights at all for country A private agents. Formally, we set:

$$e_z(s) = 0,\ z = 1, \ldots, n_A, \text{ for all } s.$$

Symmetrically, agents of country B ($z = n_A + 1, \ldots, n_A + n_B$) do not receive free shares, but have initial property rights, as described by equation (1).

3.1 Equilibrium

We consider the case where $n_A + n_B + 1 \leq S$. In this case, there may be no production in some states of nature. Thereby, markets are incomplete, and it will not be possible to eliminate all the risk by holding a portfolio of all traded assets. However, the need for assurance can be partially achieved through financial choices, but only through financial choices, as there is no technological diversification at all. Only financial diversification matters[10].

3.1.1 Country A private agents

Distributed shares are the only resources of country A private agents. Agent i solves the following program:

$$\begin{cases} \max\limits_{d_{iz},\, z=n_A+1,\ldots,n_A+n_B+1} Eu(c_i) + \overline{Ev} \\ \text{s.t.} \sum\limits_{z=n_A+1}^{n_A+n_B+1} p_z d_{iz} \leq p_g \frac{\sigma}{n_A} \end{cases} \tag{2}$$

where:

$$Eu(c_i) = \sum_{z=n_A+1}^{n_A+n_B+1} \frac{1}{S} u(d_{iz})$$

Notice that the expected utility of public good does not depend on the consumer's will. We get the following demand functions:

$$d_{iz} = \left(\frac{p_g}{p_z}\right)^{\frac{1}{1-\rho}} \frac{\frac{\sigma}{n_A}}{\sum\limits_{z=n_A+1}^{n_A+n_B+1} \left(\frac{p_g}{p_z}\right)^{\frac{\rho}{1-\rho}}},\ z = n_A + 1, \ldots, n_A + n_B + 1$$

[10] For a model stressing the duality between financial and technological diversification, see Saint-Paul [1992].

3.1.2 Country B private agents

Symmetrically, agent k solves the following program:

$$\begin{cases} \max\limits_{d_{kz},\, z=n_A+1,\ldots,n_A+n_B+1} Eu\left(c_k\right) \\ \text{s.t.} \sum\limits_{z=n_A+1}^{n_A+n_B+1} p_z d_{kz} \leq p_k \end{cases} \tag{3}$$

where:

$$Eu\left(c_k\right) = \sum_{z=n_A+1}^{n_A+n_B+1} \frac{1}{S} u\left(d_{kz}\right)$$

Let us briefly compare programs (2) and (3). The main difference lies in resources: country A agents get resources thanks to voucher distribution, whereas country B ones sale an endogenous share of their initial property rights. For country B agents we get the following demand functions:

$$d_{kz} = \left(\frac{p_k}{p_z}\right)^{\frac{1}{1-\rho}} \frac{1}{\sum\limits_{z=1}^{n_A+n_B+1} \left(\frac{p_k}{p_z}\right)^{\frac{\rho}{1-\rho}}},\ z = n_A+1, \ldots, n_A+n_B+1$$

3.1.3 General equilibrium

We have n_B+1 market-clearing conditions, corresponding to the n_B+1 assets, respectively those issued by country B private agents and the one issued by country A government (and then traded by private agents):

$$\begin{cases} \sum\limits_{z=1}^{n_A+n_B} d_{zk} = 1,\ k = n_A+1, \ldots, n_A+n_B \\ \sum\limits_{z=1}^{n_A+n_B} d_{zg} = \sigma \end{cases} \tag{4}$$

One of these equations will be redundant by the Walras' law. Besides, it is easy to check that the equilibrium will be symmetric, i.e. we have:

$$p_k = p_h \equiv P_B,\ \forall k, h \in \{n_A+1, \ldots, n_A+n_B\}$$

We can normalize the price of the privatized asset. For $\sigma > 0$, we set[11]:

$$p_g \equiv 1$$

[11] p_g is not defined for $\sigma = 0$. As we are in the general equilibrium theory context, the numeraire can be chosen arbitrarily among the set of assets. In consequence, the choice of the privatized asset as the numeraire has no effect.

3.2 Financial market development

3.2.1 Asset prices

Using the relevant demand functions in any equation of the market-clearing system (4) rewritten at the symmetric equilibrium, leads to:

$$P_B^* = \sigma^{1-\rho}$$

We notice that private asset prices are an increasing concave function of the privatization extent. But we must remember that these are relative prices, as we have normalized p_g to 1. Therefore, this implies that, not surprisingly, the relative price of the privatized assets (equal to P_B^{-1}) is a decreasing convex function of the privatization extent (what is rare is expensive).

3.2.2 Supply of private assets

Replace P_B by its equilibrium value in the supplies of private assets (in terms of share of the initial private property rights). In country B, that leads to:

$$1 - d_{kk}^* = 1 - \frac{1}{n_B + \sigma^\rho}$$

We get that:

$$\frac{\partial \left(1 - d_{kk}^*\right)}{\partial \sigma} \geq 0 \tag{5}$$

At first sight, $1 - d_{zz}$ seems to be a relevant indicator of financial market development: if $1 - d_{zz} = 0$ for every z, there is no financial market at all. Conversely, if $1 - d_{zz}$ is close to one, a large part of property rights is sold on the market. Thus, if we interpret $1 - d_{zz}^*$ as an equilibrium financial market development indicator the result (5) indicates that the impact of privatization would be positive on the foreign market.

On country B agents' side, an attractive argument is the following: risk-averse agents perceive privatization as a new risk-sharing opportunity. They will be interested in this new diversification opportunity as soon as new stocks are imperfectly correlated with existing ones (that is the case in our setup), and consistently with the seminal work by Pagano [1993], where the entrepreneur who goes public increases risk-sharing opportunities for others, privatization adds diversification possibilities, which in turn encourages listing by private firms. The difference with Pagano [1993] is that there are no reasons in our model

to get multiple equilibria due to coordination failures, because privatization is an exogenous variable for private agents.

Looking at other equilibrium demand for assets helps to understand the underlying general equilibrium mechanisms in both countries.

3.2.3 Demands for assets

It is more interesting to look not only at d^*_{kk}, but at the same time to the other demand functions. The following table presents the results.

Country A	$\frac{\partial}{\partial \sigma}$	Country B	$\frac{\partial}{\partial \sigma}$
d^*_{ik}	$(+)$	$d^*_{kk} = d^*_{kh}$	$(-)$
d^*_{ig}	$(+)$	d^*_{kg}	$(+)$

For country A agents, an increase in the privatization extent σ leads to an increase in all demands for assets. Intuitively, the resources they get thanks to the voucher distribution are allocated among all types of assets (wealth effect). Country B agents have unchanged initial resources, as they do not receive free shares of the privatized firm. But at the same time, as seen above, there is a new diversification opportunity. That leads to a trade-off: they increase their demand for privatized assets, and decrease their demand for all private assets, including their own (portfolio reallocation effect). That is basically why d^*_{kk} decreases with σ, and consequently $1 - d^*_{kk}$ increases.

3.2.4 Market capitalization

At equilibrium, market capitalization in A is simply equal to:

$$C^*_A \left(\underset{+}{\sigma} \right) = \sigma$$

The impact of privatization extent on domestic market capitalization is positive. The privatized asset is the only one quoted on the domestic market. This is simply an illustration of how voucher privatization in transition economies can create a financial market *ex nihilo*. This clearly positive direct effect of privatization on market capitalization is simply due to the listing of a new firm on the market. We can

also compute the equilibrium traded volume in A, given by:

$$V_A^* \left(\underset{+}{\sigma} \right) = n_A d_{ig}^* + n_B d_{kg}^*$$

All elements of this expression are increasing in σ. This indicator is also an illustration of how voucher privatization in transition economies can create financial activity *ex nihilo*, as soon as privatized assets are exchanged at equilibrium. This is the always the case here, because country B agents are interested in this new diversification opportunity. Thus, our simple model, based on diversification effects, helps to understand secondary market activity. Notice that this is consistent with the empirical evidence reported by Filer and Hanousek [2001]. They study public trading on the Prague Stock Exchange after voucher privatization, and report that once shares from voucher privatization were distributed, vigorous second markets developed; participants in the secondary market included, among others, international investors.

In country B, equilibrium market capitalization is equal to:

$$C_B^* \left(\underset{+}{\sigma} \right) = n_B \left(1 - d_{kk}^* \right) P_B^*$$

It is also unambiguously increasing in σ, as $1 - d_{kk}^*$ and P_B^* are increasing in σ, as explained above. At the aggregate level, world market capitalization obviously increases.

3.3 Voucher privatization and financial integration

This section focuses on international issues.

3.3.1 Equilibrium holdings of privatized assets by foreign agents

In our model agents do not cross-list firms. They simply rely on market integration to sell assets to foreign investors. Furthermore, with free distribution of public assets to domestic agents, there is no direct relation between government and foreign agents. Thus, the question of cross-listed privatization is irrelevant in this setup. However, we can compute an equilibrium holdings level of privatized assets by foreign agents. Therefore, if we do not have cross-listed privatization or sale of privatized assets to foreign agents by the government, after all we have a measure of the (indirect) transfer of assets from the public sector to foreign agents.

In the general equilibrium system (4), the market-clearing condition for privatized assets was:

$$\sum_{z=1}^{n_A+n_B} d_{zg} = \sigma$$

We define the equilibrium relative holdings of privatized assets by foreign agents as the equilibrium demand for privatized assets by country B agents divided by the equilibrium aggregate demand for privatized assets (equal to the supply of public assets, equal to privatization extent):

$$\psi \equiv \frac{\sum_{k=n_A+1}^{n_A+n_B} d_{kg}}{\sum_{z=1}^{n_A+n_B} d_{zg}}$$

At equilibrium, it can be rewritten:

$$\psi^*(\sigma) = \frac{n_B d^*_{kg}}{\sigma}$$

Replacing d^*_{kg} by its expression, we get that:

$$\psi^*\left(\underset{-}{\sigma}, \underset{+}{n_B}\right) = \frac{n_B}{n_B + \sigma^\rho}$$

$\psi^*(\sigma)$ is increasing in n_B. This is consistent with intuition: other things equal, the fraction of the stocks held by foreign investors depends on their relative absorption capacity (simply captured here by their number).

The negative dependence in σ reflects the fact that, other things equal, an increase in free resources for country A agents increases their relative weight in holdings, thereby decreasing the relative holdings by foreign agents.

In our very simple model, the (indirect) transfer of assets from the public sector to foreign agents can not be affected by political, legal, regulatory, reputation or institutional factors, although these effects find strong support in empirical analyses, for instance in Bortolotti, Fantini, and Scarpa [2000]. Besides, the determinants of equilibrium holdings by foreign agents we are able to identify would be the same if the seller would have a private identity.

3.3.2 International asset allocation strategies

In the program of a country A private agent (2), the budget constraint was:

$$\sum_{z=n_A+1}^{n_A+n_B+1} p_z d_{iz} \leq p_g \frac{\sigma}{n_A}$$

The left-hand side gives the portfolio structure of this agent. Thus, we can define the ratio of domestic investment over investment abroad simply as:

$$\delta_i \equiv \frac{p_g d_{ig}}{\sum_{k=n_A+1}^{n_A+n_B} p_k d_{ik}}$$

At equilibrium, it can be rewritten:

$$\delta_A^* (\sigma) = \frac{d_{ig}^*}{n_B P_B^* d_{ik}^*}$$

Replacing prices and demands by their expressions, we get that:

$$\delta_A^* \left(\underset{+}{\sigma}, \underset{-}{n_B} \right) = \frac{\sigma^\rho}{n_B}$$

Not surprisingly, relative domestic investment increases with σ: because of the privatization, at the individual level, country A agents are encouraged to invest more domestically, and less abroad. Broadly speaking, privatization extent is indeed an indicator of domestic diversification possibilities, whereas n_B is an indicator of foreign diversification opportunities. We can see that, symmetrically, with privatization in A, country B agents are encouraged to invest more abroad, and less domestically, by defining a symmetric ratio. For country B agents, the ratio of domestic investment over investment abroad is:

$$\delta_k \equiv \frac{\sum_{h=n_A+1}^{n_A+n_B} p_h d_{kh}}{p_g d_{kg}}$$

At equilibrium we get that:

$$\delta_B^* \left(\underset{-}{\sigma}, \underset{+}{n_B} \right) = \frac{1}{\delta_A^* (\sigma, n_B)}$$

Equilibrium relative domestic investment δ_B^* decreases with privatization extent σ in country B.

Proposition 1 *At the individual level, equilibrium relative domestic investment increases with privatization extent in the country where privatization has been implemented, and vice versa in the other one.*

This proposition is a clear illustration of diversification and portfolio reallocation effects induced by privatization.

3.3.3 Relative aggregate foreign holdings of domestic assets

Assets distributed by the government are the only ones quoted on the country A financial market. Therefore, at the aggregate level, equilibrium relative holdings of domestic assets by foreign agents are decreasing with privatization extent in this country.

Assets issued by country B private agents are quoted on the country B financial market. In the system (4), the market-clearing conditions for these assets were:

$$\sum_{z=1}^{n_A+n_B} d_{zk} = 1,\ k = n_A + 1, \ldots, n_A + n_B$$

We define ϕ_B, the ratio of relative foreign holdings of domestic assets, as follows:

$$\phi_B \equiv \frac{\sum_k \sum_i d_{ik}}{n_B}$$

At equilibrium we get:

$$\phi_B^* \left(\underset{+}{\sigma} \right) = n_A d_{ik}^*$$

$\phi_B^*(\sigma)$ is increasing in σ, as d_{ik}^* is itself increasing in σ. All forces play in the same sense, domestic demand decreases (portfolio reallocation effect, because of the new risk-sharing opportunity, at constant resources) while foreign demand increases (thanks to the additional resources, optimally allocated among all available assets).

Proposition 2 *Under voucher privatization, at the aggregate level, relative foreign holdings of domestic assets decrease with privatization in the country where privatization has been implemented, and vice versa in the other one.*

The asymmetric wealth effect described above (i.e. the fact that free resources agents get thanks to voucher distribution in country A are allocated optimally among all types of assets) increases with privatization extent. As a consequence, the share of country A agents in assets holdings increases with privatization extent in both countries.

4 SIP and public risk-sharing in developed market systems

If we consider now a developed market system, we shall assume now that all agents, including country A private ones, have symmetric initial property rights, i.e. that the endowment of agent z is equal to:

$$e_z(s) = \begin{cases} 1 \text{ if } s = z \\ \\ 0 \text{ otherwise} \end{cases}, \text{ for all } z = 1, \ldots, n_A + n_B + 1$$

Besides, we focus now on share issue privatizations (SIPs). In the first period the government sells shares of its property right on a financial market. As the government sells, it gets a revenue from the privatization. We assume that, thanks to this first-period revenue, the government buys a diversified portfolio, which is precisely constituted by the assets sold by the private agents. We assume here that the government keeps its diversified portfolio at the end of the first period, and thereby may have an additional endowment in the second period, to be transformed in public good.

We take this policy as given, and focus on financial effects. As it maximizes the utility of a representative agent, the government now plays as a $(n+1)$th risk-averse agent on the financial market. Notice that if taxes are not available, this is the only privatization method that allows the diversification of public good provision across the different states of nature; it might even lead to the first best of this economy.[12]

4.1 Equilibrium

Agent i (of country A) now solves the following program:

$$\begin{cases} \max\limits_{d_{iz},\, z=1,\ldots,n_A+n_B+1} Eu(c_i) + \overline{Ev} \\ \text{s.t.} \sum\limits_{z=1}^{n_A+n_B+1} p_z d_{iz} \leq p_i \end{cases}$$

Compared to program (2), the budget constraint is modified, because private agents do not get free shares. This budget constraint is now perfectly similar to the one of agent k (of country B). Thus, analytically,

[12] For the optimal privatization combination and an analysis in terms of real effects in a closed-economy setup, see Bosi, Girmens, and Guillard [2001].

we only have one type of private agent z ($z = 1, \ldots, n_A + n_B$), solving the following program:

$$\begin{cases} \max\limits_{d_{zz'},\, z'=1,\ldots,n_A+n_B+1} Eu\left(c_z\right) \\ \text{s.t.} \sum\limits_{z'=1}^{n_A+n_B+1} p_{z'} d_{zz'} \leq p_z \end{cases}$$

We get the following demand functions:

$$d_{zz'} = \left(\frac{p_z}{p_{z'}}\right)^{\frac{1}{1-\rho}} \frac{1}{\sum\limits_{z'=1}^{n_A+n_B+1} \left(\frac{p_z}{p_{z'}}\right)^{\frac{\rho}{1-\rho}}},\ z' = 1, \ldots, n_A + n_B + 1 \tag{6}$$

In addition, we have now to take into account the objective function, as well as the budget constraint of the country A government. It maximizes the utility of a representative agent, allocating resources taken from privatization among all available assets:

$$\begin{cases} \max\limits_{d_{gz},\, z=1,\ldots,n_A+n_B} \overline{Eu} + Ev\left(G\right) \\ \text{s.t.} \sum\limits_{z=1}^{n_A+n_B} p_z d_{gz} \leq p_g \sigma \end{cases}$$

where:

$$Ev\left(G\right) = \sum_{z=1}^{n_A+n_B} \frac{1}{S} w\left(d_{gz}\right) + \frac{1}{S} w\left(1-\sigma\right)$$

The general equilibrium system is also modified, as follows:

$$\begin{cases} \sum\limits_{z=1}^{n_A+n_B+1} d_{zz'} = 1,\ z' = 1, \ldots, n_A + n_B \\ \sum\limits_{z=1}^{n_A+n_B} d_{zg} = \sigma \end{cases} \tag{7}$$

4.2 Financial market development

4.2.1 Asset prices

One of the equations in system (7) is redundant by the Walras law. Once again, the equilibrium is symmetric, i.e. we have:

$$p_z = p_{z'} \equiv P,\ \forall z, z' \in \{1, \ldots, n_A + n_B\}$$

Private asset prices are equal in both countries. Normalizing again the price of the privatized asset and using the relevant demand functions (6) in the market-clearing system (7), rewritten at the symmetric equilibrium, we get that:

$$\frac{\left(n_A + n_B\right)\left(P^*\right)^{\frac{1}{1-\rho}}}{\left(P^*\right)^{\frac{\rho}{1-\rho}} + n_A + n_B} = \sigma$$

Thus, unambiguously:

$$\frac{\partial P^*}{\partial \sigma} > 0$$

Therefore the general equilibrium relative price of private assets is still a strictly increasing function of the privatization extent. The price mechanism described in the case of voucher privatization is supplemented here by an exogenous demand effect, related to government expenses in a diversified portfolio.

4.2.2 Supply of private assets

Equilibrium supplies of private assets are given by:

$$1 - d^*_{zz} = 1 - \frac{1}{n_A + n_B + (P^*)^{\frac{\rho}{1-\rho}}}$$

Equilibrium supplies of private assets are increasing in the equilibrium private asset price, itself increasing in privatization extent, such that:

$$\frac{\partial \left(1 - d^*_{zz}\right)}{\partial \sigma} \geq 0,\ z = 1, \ldots, n_A + n_B$$

The financial diversification effect (other things equal, agents decrease all their demands, including the demand addressed to their own assets, thus mechanically increase the supply of these assets) is now supplemented by the demand effect: the demand expressed by the government for a diversified portfolio increases the price of private assets and their equilibrium supply.

4.2.3 Demands for assets

The equilibrium being symmetric, we have the following demand functions:

$$\begin{aligned} d^*_{zz'} &= \frac{1}{n_A + n_B + (P^*)^{\frac{\rho}{1-\rho}}},\ z' = 1, \ldots, n_A + n_B \\ d^*_{zg} &= (P^*)^{\frac{1}{1-\rho}} \frac{1}{n_A + n_B + (P^*)^{\frac{\rho}{1-\rho}}} \end{aligned}$$

We get consequently the evolution of these functions depending on privatization extent:

	$\frac{\partial}{\partial \sigma}$
$d^*_{zz} = d^*_{zz'},\ z' = 1, \ldots, n_A + n_B$	$(-)$
d^*_{zg}	$(+)$

(8)

Though the demand effect (increase in government demands, and in asset prices), there is a trade-off: private agents increase their demand for privatized assets, and decrease their demands for all private assets, including their own. This illustrates again the diversification effect (portfolio reallocation) of privatizations.

4.2.4 Market capitalization

Market capitalization increases in both countries, but faster in the country where privatization has been implemented. The difference is only due to the quotation of privatized assets on the domestic market, *private* market capitalizations being similarly (and positively) affected in both countries. Obviously, this result does not hold if we allow a cross-listed privatization: in this case, market capitalization increases in both countries, but faster in the country where the government decides to sell the largest share of the privatized assets.

4.3 Share issue privatization and financial integration

4.3.1 Equilibrium holdings of privatized assets by foreign agents

Once again, agents do not cross-list firms: they simply rely on markets integration to sell assets to foreign investors. But there is now a direct relation between government and foreign agents. Thus the question of cross-listed privatization, in the usual sense of the term is once again irrelevant, as we can not explain the decision to list or not abroad, but we can compute the percentage of capital to be sold (at equilibrium) to foreign investors by the government.

At equilibrium, the ratio ψ (equilibrium relative holdings of privatized assets by foreign agents) is now equal to:

$$\psi^* = \frac{n_B d^*_{kg}}{n_A d^*_{ig} + n_B d^*_{kg}}$$

We get that:

$$\psi^* = \frac{n_B}{n_A + n_B}$$

This ratio depends on the relative sizes of countries, as in the case of voucher distribution, and for

the same reasons (relative absorption capacities). But now, and not surprisingly, it does not depend on privatization extent σ. For instance, in the case $n_A = n_B$, foreign agents obviously hold 50% of the privatized assets, for all privatization levels.

4.3.2 International asset allocation strategies

We will see that proposition 1 remains true. The ratio of domestic investment over investment abroad is now defined as follows, for an agent i of country A:

$$\delta_i \equiv \frac{\sum_{j=1}^{n_A} p_j d_{ij} + p_g d_{ig}}{\sum_{k=n_A+1}^{n_A+n_B} p_k d_{ik}}$$

At equilibrium:

$$\delta_A^* \underset{+\ +\ -}{\left(\sigma, n_A, n_B\right)} = \frac{n_A + (P^*)^{\frac{\rho}{1-\rho}}}{n_B}$$

Not surprisingly, it is increasing in n_A, decreasing in n_B, and increasing in P^*, thus increasing in privatization extent σ.

For country B agents, the ratio of domestic investment over investment abroad is now:

$$\delta_k \equiv \frac{\sum_{h=n_A+1}^{n_A+n_B} p_h d_{kh}}{\sum_{i=1}^{n_A} p_i d_{ki} + p_g d_{kg}}$$

We check once again that, at equilibrium:

$$\delta_B^* \underset{-\ -\ +}{\left(\sigma, n_A, n_B\right)} = \frac{1}{\delta_A^*\left(\sigma, n_A, n_B\right)}$$

Thus proposition 1 remains true: equilibrium relative domestic investment increases with privatization extent in the country where privatization has been implemented, and vice versa in the other one. This still illustrates that privatization creates new diversification opportunities. This effect may play, even if there are preexisting financial markets. It is not inconsiderable, as soon as we see agents in terms of industries, rather than in terms of firms.[13]

[13] Think, for instance, about the privatization of telecommunication companies in developed countries.

4.3.3 Relative aggregate foreign holdings of domestic assets

Finally, we look at the ratio of relative foreign holdings of domestic assets, at the aggregate level. In country A, assets issued by country A private agents and those distributed by the government to these agents are quoted on the domestic market. We find that the privatization impact on the ratio of relative foreign holdings of domestic assets is ambiguous, such that under SIP, proposition 2 does not hold for this market.

However, in country B, proposition 2 still holds for SIP. Quoted from the system (7), the clearing condition for this market is:

$$\sum_{z=1}^{n_A+n_B+1} d_{zk} = 1,\ k = n_A + 1, \ldots, n_A + n_B \tag{9}$$

Therefore, relative foreign holdings are now given by:

$$\phi_B \equiv \frac{\sum_k \sum_i d_{ik} + \sum_k d_{gk}}{n_B}$$

At equilibrium that can be rewritten:

$$\phi_B^* (\sigma) = n_A d_{ik}^* + d_{gk}^*$$

Using (9), we notice that:

$$\phi_B^* (\sigma) = 1 - n_B d_{hk}^*$$

The demand for domestic assets by country B agents being decreasing in privatization extent (see result (8)), that leads to:

$$\frac{\partial \phi_B^*}{\partial \sigma} > 0$$

In country B, relative foreign holdings of domestic assets increase with privatization extent, as stated by proposition 2 in the case with voucher privatization.

5 Concluding remarks

This paper has presented a two-period general equilibrium model of an open-economy, in which we have introduced State-owned property rights to focus on financial effects of privatization. We have in particular

shown how privatization could induce portfolio reallocations, for diversification purposes.

To take into account an exogenous initial imperfect integration, the theoretical framework developed here can be expanded with international trading costs. We can assume that asset buyers face an international trading cost, for instance reducing the dividend in the second period. This cost would capture the various costs to buy (or equivalently, to sell) assets to foreign agents, such as financial intermediation, exchange rate transaction costs or information costs and asymmetries.[14] Equivalently, we can consider a trading cost proportionally increasing the foreign asset prices in the first period. Taking international trading costs into consideration would help to be more consistent with empirical analyses. When Portes and Rey [2000] present empirical evidence on the determinants of cross-border equity flows, they claim that the most important determinants are market sizes, as well as the efficiency of transactions, and distance (as a proxy for information asymmetries); consequently, in the equation they want to estimate, aggregate demand for country A assets from country B depends basically of the measure of the sizes of the countries and on a trading cost term (representing both information cost and the efficiency of the transaction technology). Moreover, we have seen that we can not have political, legal, regulatory, reputation or institutional effects although they find strong support in empirical analyses, for instance in Bortolotti, Fantini, and Scarpa [2000], but a trading cost parameter may precisely contain some of these effects.

With such costs, expected utilities and/or budget constraints expressions are altered, thereby modifying the general equilibrium system to be solved to get equilibrium prices. Taking trading costs into account, numerical simulations have to be performed to solve the system (unfortunately, the system can not be analytically solved).[15] However, even if the equality between private asset prices is immediately broken, we guess that the results shown above are not dramatically inverted, but simply toned down as costs increase; finally, under very high costs, we simply tend to the closed-economy case. With free distribution of public assets, uniformly distributed property rights are not traded and privatization has no financial effects, neither in the country where it has been implemented, nor abroad. With share issue

[14] See Gordon and Bovenberg [1996], Martin and Rey [2000] and Portes and Rey [2000] among others.

[15] Another argument against iceberg costs is that they introduce a kind of "black box", whereas one of the main innovations of the model is to take explicitely into account all interdependeces..

privatization, there will be financial effects, but concentrated in the country where privatization has been implemented.

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