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SHARING RISK WITHIN AND ACROSS COUNTRIES: THE ROLE OF LABOR MARKET INSTITUTIONS

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Sharing risk within and across countries: the role of labor market institutions

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ABSTRACT

This paper studies the effect of labor market institutions on within- and cross-country risk-sharing using a model of international trade in risky assets modified to include a subset of agents, labor-owners, who do not access financial markets, and employment security provisions. Labor market institutions, by promoting within-country risk-shifting arrangements between agents with or without access to financial markets, reduce the fluctuations of non-tradable labor incomes and amplify the fluctuations of capital incomes. Capital flows become more volatile across countries, and if the configuration of labor markets differs across countries, capital-owners bear the burden of systematic undiversifiable world aggregate uncertainty.

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1. Introduction

This paper shows in theory that, when risks cannot be fully diversified on financial markets, labor market institutions meant to promote risk-shifting arrangements between agents with or without access to financial markets may affect the response of aggregate consumption and capital income flows to country-specific income shocks.

The analysis relates to studies belonging to two different fields of the literature, namely labor economics and international economics. According to the social insurance approach to institutional analysis, while the introduction of labor market institutions may be hardly motivated in a frictionless economy where workers can perfectly insure against labor income risk, institutional features such as employment protection legislation (Lazear, 1990; Bertola, 2004) and wage setting (Agell, 2002) may represent second-best instruments for sharing risk under incomplete financial markets. In labour economics, the effect of labor market institutions has been studied extensively in a closed economy framework, where shocks are idiosyncratic to individual workers or firms, from a comparative static perspective (see e.g. Devereux and Lockwood, 1991; Bean and Pissarides, 1993; Bertola, 1994). Recent studies have also addressed the topic using new Keynesian settings with search and matching frictions to derive implications for business cycle fluctuations. For instance, Zanetti (2011) shows in a dynamic stochastic general equilibrium model that the volatility of output decreases in the strictness of employment protection legislation, as well as employment and job flows, while the volatility of inflation increases as firms adjust to business cycles fluctuations through prices. From an open economy perspective, Bertocchi (2002) shows that the structure of labor markets affects the way within-country income distribution responds to globalization forces, and that the share of incomes that goes to labor is higher in countries with stronger trade unions.

This paper extends the labor economics studies mentioned above, that focus on the impact of institutions on workers behaviour and on the size of income shares, to consider the possibility that income shares change in response to shocks, in ways that depend on labor market institutions. Developing an argument by Bertola and Drazen (1994), who suggested that labor market institutions may be relevant to capital income flows if they foster income redistribution across individuals who differ in their ability to access

financial markets for consumption smoothing purposes, it shows how institutionally provided risk-shifting may actually work.

The analysis proposed is linked also to a recent literature in international economics that acknowledges the importance of within-country risk-sharing and limited participation in asset markets to help explain puzzling international evidence on the consumption-real exchange rate puzzle. Kocherlakota and Pistaferri (2007) show that when people cannot insure against individual shocks within country borders, the effect of these shocks influences the prices of international assets. Kollmann (2012) and Devereux et al. (2012) relate the consumption-real exchange rate anomaly to the presence of households that cannot access financial markets and hence consume all their current labor income. Differently from those studies, this paper models explicitly the mechanism whereby labor markets may affect macroeconomic outcomes when a country is hit by a country-level income shock, and relates within-country risk-reallocation to institutionally-related income distribution between agent types.

Bringing together insights from labor economics and international economics, the present work contributes to the existing literatures by offering a stylized model to study the qualitative implications of labor market institutional frameworks on both within-country and cross-country risk sharing.

The theoretical framework is based on a model of international trade in risky assets modified to account for the existence of non-Ricardian consumers, identified as labor-owners, and for the presence of labor market institutions that reallocate risk between agent-types.[1] The world economy lasts for two periods and consists of two countries, home and foreign, inhabited by two types of agents, capital-owners and labor-owners. Capital is free to move internationally, while labor is completely immobile across countries. Each country produces a single tradable good, which can be either consumed or invested, by using a constant returns to scale technology, and faces second-period uncertainty in the form of an exogenous country-specific productivity shock. While capital-owners ("investors") can access financial markets to insure and smooth their

[1] In this framework, the existence of non-Ricardian (rule-of-thumb) agents who consume their whole current labor income is linked to the lack of access to international capital markets (as, for instance, in Kollmann, 2012). Of course, rule-of-thumb behavior can be interpreted in several ways as a consequence of myopia, ignorance of intertemporal trading opportunities, etc.

consumption profile, international financial markets are imperfect, as labor-owners ("workers") cannot borrow nor lend, and incomplete, as there exists no insurance against labor-income fluctuations. In this framework, the only assets traded are forward contracts on income earned by capital. The key elements of the income insuring mechanism whereby labor market institutional features may shield otherwise uninsured labor incomes are illustrated by incorporating in the model job security provisions in the form of adjustment costs.

The main results of the model are that country-specific institutional insurance channels, by promoting risk-reallocation within national borders, reduce labor income fluctuations and, at the same time, imply a higher volatility of those national income components which can be traded on international financial markets. Moreover, in a world where countries differ according to their institutional structures, investors, besides more volatile capital incomes, will bear the burden of systematic undiversifiable world aggregate uncertainty.

The model has the advantage to uncover a novel channel of interaction between labor market institutions and macroeconomic shocks in the simplest yet consistent with the empirical evidence framework. Indeed, while its results on the consequences of adjustment costs on labor share dynamics, and in turn on consumption and capital flows, do not hinge on simplifying assumptions that might be relaxed in future work, the quantitative relevance of such mechanisms has been documented by recent empirical studies. Employment protection legislation and other labor market institutional dimensions have been found to play a role in shaping the response of unemployment to macroeconomic shocks (Blanchard and Wolfers, 2000, and Bertola et al., 2007) and, in simulation analyses, in affecting business cycle fluctuations (Zanetti, 2011). More closely to the present analysis, in a companion paper Lo Prete (2013) documents in a panel of OECD countries that aggregate consumption responds less to country-level income shocks where employment protection legislation and other labor market institutions help providing risk-shifting arrangements within country borders.

The paper is organized as follows. The functioning of labor and capital markets is analyzed in Sections 2 and 3, respectively. The equilibrium international allocation of tradable wealth and consumption levels for workers and investors is derived in Section 4 under the assumption of homogenous institutional settings across countries. Section 5 extends the model to the case of a world economy which consists of two countries with heterogeneous institutional settings. Section 6 concludes.

2. Domestic labor markets

Consider an economy where a single good is produced using a constant returns to scale technology, capital is free to move internationally, and labor is immobile across countries. The productive sector can be represented by a competitive firm, or by a continuum of identical risk-neutral firms whose size is normalized to unity, producing output according to a Cobb-Douglas production function $Y_t^i \equiv A_t^i K_t^{1-\alpha}(L_t^i)^{\alpha}$, where i indexes the second-period state of nature, Y_t^i denotes output produced at time t using capital (K_t) and labor (L_t^i), and A_t^i is a productivity indicator. To model second period uncertainty, assume for simplicity that there exist two states of nature, "good" ($i = g$) and "bad" ($i = b$), occurring with equal probability π^i (i.e. $\pi^i = 1/2$ for ∀i), and that the economy faces exogenous productivity shocks such that $A_2^b < A_1 < A_2^g$. Fluctuations in productivity imply equally exogenous labor demand (L^D) fluctuations whereby $L_2^{Db} < L_1^D < L_2^{Dg}$.

Let identical risk-averse workers constitute an indefinitely divisible labor force whose size is constant and set equal to L_{1f}. Each worker derives utility from consumption (out of wage incomes) and leisure, and labor force participation decisions may be represented by a well-behaved aggregate labor supply (L^S): once the wage exceeds an exogenous constant reservation wage ($\widehat{w}$), the supply of labor is an increasing and convex function of the wage.

In this stochastic environment, labor owners cannot access financial markets to smooth consumption across periods nor states of nature. The lack of complete markets motivates the introduction of labor market policies meant at protecting otherwise uninsured labor owners by introducing a non-market insurance component in workers' disposable incomes. Social insurance may be provided by several institutional features such as job security provisions (Bertola, 2004), wage setting (Agell, 2002), and unemployment insurance benefits (Acemoglu and Shimer, 1999). In the following analysis, the key elements of an income insuring mechanism whereby labor market institutional features may cause the joint dampening of employment and wage fluctuations will be illustrated by introducing in a stylized but useful model job security provisions in the form of adjustment costs.[2]

[2] It would be possible to model also wage bargaining, but this element would not improve on the analysis of the mechanism that links labor market features to macroeconomic outcomes in the present context.

2.1. Adjustment costs and dynamic labor demand

To represent the impact of job security provisions on labor market outcomes, it is possible to use a two-period version of the stochastic labor demand model in Bertola (1990), and consider a risk-neutral firm which chooses employment to maximize its present and expected profits in an economy where adjusting the size of the labor force entails some costs.

In a stochastic framework, employment is jointly affected by hiring and firing costs as the firm takes into consideration that, in the future, business conditions may turn good or bad, and thus may imply hiring or firing decisions. The specification of adjustment costs is kept as simple as possible by assuming that the firm pays some cost for each unit of labor hired or dismissed according to the following piecewise linear cost function, Z(·):

$$\begin{aligned} Z^i(\Delta L) &= Z\left(L_2^i - L_1\right) \quad \text{if} \quad i = g: L_2^g - L_1 > 0 \\ &= -Z\left(L_2^i - L_1\right) \quad \text{if} \quad i = b: L_2^b - L_1 < 0 \,. \end{aligned}$$

Hiring and firing costs per unit of labor are supposed to be given, constant and symmetric, and their total amount to depend on the size of the variation in employment (i.e. $L_2^i - L_1$). The functional form used to represent adjustment costs is of course relevant to describe the process whereby labor demand responds to shocks. In this model, linearity and symmetry allow studying the consequences of adjustment costs on labor share dynamics in a simple yet rigorous framework. More complicated functional forms meant to capture somehow more realistic features of the data would not add to the understanding of the mechanisms at the core of the present paper's analysis. For instance, asymmetries in the form of costs that apply only or mainly to employment contractions, would change the decision in the first period but not the fact and the way the consequences of the income shocks are smoothed. And quadratic adjustment costs would affect the way the shock is distributed between labor and capital owners but not the main predictions of the model about the shifting of risk between the two types of agents. Leaving to future research the task of relaxing such assumptions, the following analysis will abstract from these considerations to focus on uncovering the mechanism that explains how labor market institutions and aggregate shocks may interact differently across countries.[3]

[3] For a discussion about how the model may be extended in further work, and about the future lines of research that the present analysis suggests, see Section 6.

After the occurrence of the shock, labor inputs can be immediately adjusted. Let the firm initiate all separations. Then, in the first period it solves the problem

$$\max_{L_1} Y_1 - w_1 L_1 + \sum_{i=g,b} \frac{\pi^i}{1+r} \left[Y_2^i - w_2^i L_2^i - Z^i (L_2^i - L_1) \right],$$

where r is the equilibrium real interest rate in the world economy. First order conditions with respect to L_1 yield

$$MP_1^L = \frac{\partial Y_1}{\partial L_1} = w_1 - \sum_{i=g,b} \frac{\pi^i}{1+r} Z^i ,$$

where MP_1^L indicates the marginal product of labor in period one. Since hiring and firing costs are symmetric, the second term on the right hand-side representing the expected value of adjustment costs is zero. Thus, the firm adjusts its labor force up to the point where the marginal product of labor is equal to the competitive wage: $\frac{\partial Y_1}{\partial L_1} = w_1$.

In the second period, first order conditions

$$MP_2^{Li} = \frac{\partial Y_2^i}{\partial L_2^i} = w_2^i + Z^i$$

imply that adjustment costs drive a wedge between the marginal product of labor and the wage that the firm pays to employees. In periods of expansions (recessions) labor is paid less (more) than its marginal product and employment turns out to be lower (higher) than what it would be in a *laissez faire* economy, thus reducing labor demand fluctuations.

2.2. Labor share dynamics

In the first period there is no uncertainty and consumable output $Y_1 \equiv A_1 K_1^{1-\alpha} L_1^{\alpha}$, where K_1 is given, is divided between capital and labor according to constant factor shares: $1 - \alpha = \frac{r_t K_t}{Y_t}$ and $\alpha = \frac{w_t L_t}{Y_t}$. In the second period, the economy is hit by a country-specific exogenous shock, and labor market policies work to partially smooth-out its effects. Following Kessing (2003), it is possible to show that in the presence of adjustment costs and with a Cobb-Douglas technology, the labor share is unambiguously decreased when business conditions turn good and increased when business conditions turn bad. For a fixed productivity level A, and at the given wage w, the effect of an increase in employment on the second period labor share, denoted $\gamma^i = (\gamma^g, \gamma^b)$, is

$$\frac{\partial \gamma^i}{\partial L_2^i} = \frac{w(Y_2^i - L_2^i MP_2^{Li})}{(Y_2^i)^2} > 0.$$

Hence, there is a positive correlation between the labor share and employment dynamics, and since adjustment costs imply a decrease (increase) of labor demand in good (bad) times with respect to the case of a frictionless economy, the labor share will be biased downward (upward).

Let us define "risk-reallocation margin" the portion of total income which is reallocated from labor to capital once the shock has occurred,

$$\left(MP_2^{Li} - w_2^i\right)L_2^i = Z^i L_2^i.$$

This amount equals the wedge between the marginal revenue product of labor and the wage paid to workers (i.e. $MP_2^{Li} - w_2^i$) multiplied by the (institutionally constrained) second period employment level (L_2^i). In the good state, the risk-reallocation margin is a positive amount ($Z^g > 0$); in the bad state, it is a negative quantity ($Z^b < 0$). Graphically, the state-contingent risk-reallocation margins are the grey areas in Figure 1, where free-market outcomes are denoted by a tilda and the dashed downward sloping schedules represent the labor demand curves in the presence of adjustment costs. The interpretation of the figure is straightforward. The labor market clears at the wage level that equates labor demand and labor supply. Points G and B denote the *laissez faire* equilibria in good and bad times, respectively. When firms face a well-behaved upward-sloping labor supply, and turnover costs drive a wedge between the marginal product of labor and the wage, the labor market clears at point F when business conditions turn good, and at point D when business conditions turn bad. Thus, legal restrictions to hiring and firing reduce both employment fluctuations and upward (downward) pressures on wages in good (bad) times, leading to a compression of wages across states of nature. The joint reduction of wage and employment adjustments unambiguously decreases labor income fluctuations with respect to a free-market economy: in good times workers' surplus is decreased by the area $\widetilde{w_2^g}GFw_2^g$, while in bad times it is increased by the area $w_2^b DB\widetilde{w_2^b}$.

Unlike the factor shares implied by a Cobb-Douglas production function, in the presence of social insurance provisions the second period labor share

$$\gamma^i = \frac{w_2^i L_2^i}{Y_2^i} = \frac{\left(MP_2^{Li} - w_2^i\right)L_2^i}{Y_2^i} = \alpha - \frac{Z^i L_2^i}{Y_2^i}$$

is state-contingent and negatively correlated with the productivity shock: it increases in bad times ($\gamma^b > \alpha$), and decreases when business conditions turn good ($\gamma^b < \alpha$).

2.3. Workers' problem

Labor income owners supply labor to the productive sector at any wage higher than an exogenous reservation wage, $\widehat{w}$, and derive utility from both consumption and leisure. In this economy, as for instance in Kollmann (2012), it is the limited participation in assets' trade that explains rule-of-thumb behavior for decision making. Since each worker cannot access financial markets for consumption smoothing purposes, she behaves as a non-Ricardian agent who consumes her entire current income, $C_t^{Wi} = Y_t^{Wi} = w_t^i L_t^i$.

In the first period, when no social insurance mechanism is at work, the labor-income share equals the constant share implied by the Cobb-Douglas production function and labor is paid its marginal product: $C_1^W = Y_1^W = \alpha Y_1 = w_1 L_1$. In period two, as a shock hits the country, the social insurance mechanism partially smoothes out labor income fluctuations:

$$C_2^{Wi} = w_2^i L_2^i = \left(\alpha - \frac{Z^i L_2^i}{Y_2^i}\right) Y_2^i = \alpha Y_2^i - Z^i L_2^i \,, \tag{1}$$

as workers receive and consume a lower share of national incomes in good times and a higher share in bad times.

3. Domestic capital markets

This Section characterizes investment decisions and the allocation problem of investors in the domestic country, assuming that the world economy consists of two countries, home ($j = h$) and foreign ($j = f$), and that capital is free to move across borders.

3.1. Firms' investment decision

The domestic representative firm hires internationally immobile labor as described in Section 2, and rents capital from capital-owners. Investment decision are made in the first period to maximize the present value of current and future dividends, given the initial amount of capital available in the country, K_1^j. Omitting for ease of notation the country index, dividends are defined as current profits net of investment expenditures:

$$d_t^i = Y_t^i - w_t^i L_t^i - I_t = \left(1 - \gamma^i\right) Y_t^i - I_t.$$

The firm's market value on date 1 corresponds to the present discounted value of its future uncertain dividend stream:

$$V_1 = \sum_{i=g,b} \pi^i \frac{d_2^i}{1+r}.$$

In each period the firm pays out dividends equal to its current profits net of investment,

$$d_1 = Y_1 - w_1 L_1 - I_1 = (1-\alpha)Y_1 - I_1 \,,$$
$$d_2^i = \left(1 - \alpha + \frac{Z^i L_2^i}{Y_2^i}\right) Y_2^i - I_2 = (1-\alpha)Y_2^i + Z^i L_2^i - I_2 \,,$$

where by assumption investment I_t is fully reversible and capital does not depreciate, so that the amount of capital $K_2 = K_1 + I_1$ accumulated in period one will be trivially consumed at the end of period two (i.e. $K_2 = -I_2$). Then, the firm solves

$$\max_{I_1}(d_1 + V_1) =$$
$$\max_{I_1} \; A_1 K_1^{1-\alpha} L_1^{\alpha} - w_1 L_1 - I_1 + \sum_{i=g,b} \frac{\pi^i}{1+r}\left[(1-\alpha)A_2^i K_2^{1-\alpha}(L_2^i)^{\alpha} + Z^i L_2^i - I_2\right].$$

First order conditions with respect to investment,

$$1 = \sum_{i=g,b} \frac{\pi^i}{1+r}\left[(1-\alpha)A_2^i F_{I_1}\left(K_2, L_2^i\right) + 1\right], \tag{2}$$

indicate that to maximize profits the firm invests up to the point where the shadow price of an extra unit of capital invested (the term on the left hand-side) equals the second-period discounted marginal value product of investment (the term on the right hand-side). This latter does not depend on country-specific risk-reallocation policies. It is built up by two components: the expected discounted marginal product of investment in period two and the shadow price of capital on date two, equal to the net marginal revenue by disinvesting at the end of the period (i.e. +1).

3.2. Investors' problem and portfolio allocation

Capital owners (investors) rent capital to the productive sector and demand shares of the firms which are collateralized one-to-one by capital. They are free to allocate funds anywhere in the world and can convert capital into consumption at zero costs.

In the first period, home country's capital owners own all the claims to domestic production. Denoting with x_{jt}^h the share of country j productive units held by home investors at time t, then $x_{h1}^h = 1$ and $x_{f1}^f = 1$. Investors can divide their first period dividend income between consumption and savings; these latter may take the form of net bond purchases (B_2) and net purchases of shares in foreign country's future tradable output (x_{f2}^h). Thus, capital owners' consumption depends on interest income on riskless bonds and on dividend income.

The domestic investor in the home country maximizes her lifetime expected utility, measured in the first period as the average lifetime utility given the chosen contingency plans for future consumption,

$$U_1^h \equiv u\left(C_1^{Ph}\right) + \beta E_1\left[u\left(C_2^{Ph}\right)\right],$$

where β is the subjective discount factor. The index P, which indicates investors, will be omitted in the remaining part of this Subsection. Denoting with V_1^j the date 1 price of a claim to country j's uncertain future dividends and with d_1^j country j's period t dividend income, in the two periods the domestic investor faces the following financial constraints:

$$C_1^h + B_2^h + \sum_{j=h,f} V_1^j \, x_{j2}^h \le d_1^h x_{h1}^h + V_1^h x_{h1}^h = d_1^h + V_1^h \tag{3}$$

$$C_2^{hi} \le (1+r)B_2^h + \sum_{j=h,f} d_2^{ji} \, x_{j2}^h \tag{4}$$

Solving for net bond purchases and portfolio shares in country j's production, necessary and sufficient first-order conditions are

$$u'\left(C_1^h\right) = (1+r)\beta \textstyle\sum_{i=g,b} \pi^i u'\left[C_2^{hi}\right] = (1+r)\beta E_1\left[u'\left(C_2^h\right)\right], \quad \text{and} \tag{5}$$

$$V_1^j u'\left(C_1^h\right) = \beta \textstyle\sum_{i=g,b} \pi^i u'\left[C_2^{hi}\right] d_2^{ij} = \beta E_1\left[u'\left(C_2^h\right) d_2^j\right]. \tag{6}$$

The stochastic Euler equation for "shadow" riskless bonds (5) can be written as

$$\frac{\beta E_1\left[u'\left(C_2^h\right)\right]}{u'\left(C_1^h\right)} = \frac{1}{1+r} \tag{7}$$

and indicates that the expected marginal rate of substitution of present to future consumption equals the relative price of certain future consumption in terms of present consumption.

Recalling from (6) that the marginal utility cost to a home country's investor who purchases a claim to country j's future dividends on date 1 must equal her expected marginal utility gain,

$$V_1^j = E_1\left[\frac{\beta u'(C_2^h)}{u'(C_1^h)} d_2^j\right] \tag{8}$$

is the share prices' expression.

4. Two-country global equilibrium model

This Section derives the equilibrium international allocation of tradable wealth and consumption levels for workers and investors assuming that countries are similar in every respect except for the realization of the idiosyncratic second-period shock.

While workers are constrained to consume their total earnings and their allocation problem is trivially solved, a period utility functional form needs to be specified for capital-owners. Let domestic and foreign investors have identical constant relative risk aversion (CRRA) utility functions,

$$u(C) = \frac{1}{1-\rho} C^{1-\rho} \quad \rho > 0, \rho \neq 1$$
$$= \log(C) \quad \rho = 1$$

where ρ is the coefficient of relative risk aversion. And define country j's share of initial world tradable output as

$$\mu^j = \frac{d_1 + V_1}{\sum_{j=h,f}\left(d_1^j + V_1^j\right)}.$$

Investment decisions do not depend on domestic consumption preferences and, hence, on the nationality of firms' owners. As domestic and foreign firms maximize their current and future dividends' stream, equation (2) holds in both countries. In the world economy, the marginal value product of investment in the second period,

$$\sum_{i=g,b} \pi^i (1-\alpha) A_2^i F_{I_1}\left(K_2, L_2^i\right) = r \ ,$$

is the same everywhere.

4.1. Portfolio plans and consumption levels

Given the symmetry between the home and the foreign country, for ease of notation in what follows the model will be solved from the perspective of the home country only. Consider, first, how investors diversify internationally their portfolios to pool country-specific risks. Following Obstfeld and Rogoff (1996), the model is solved recursively taking the "educated guess" that the equilibrium allocation is Pareto-efficient and, then, supporting this conjecture by finding equilibrium portfolios and prices.

Assuming that the share that each country owns of world tradable wealth stays constant over time and across states of nature, investors' equilibrium consumption levels are

$$C_1^{Ph} = \mu^h \sum_{j=h,f} d_1^j = \mu^h d_1^A \tag{9}$$

$$C_2^{Ph} = \mu^h \sum_{j=h,f} d_2^{ij} = \mu^h d_2^A \tag{10}$$

where the apex A indicates aggregate (world-wide) quantities. The second period equilibrium consumption level (10) is consistent with the home country budget constraint

(4) if the home investor holds a share μ^h of the global mutual fund (i.e. $x_{f2}^h = \mu^h$) and no bonds holdings (i.e. $B_2^h = 0$).

When home and foreign investors choose simultaneously consumption and portfolio plans, allocations are globally feasible and characterize the economy's equilibrium when bond prices satisfy (7), that is, when the equilibrium real interest rate is

$$1 + r = \frac{1}{\beta}\left(\frac{d_1^A}{d_2^A}\right)^{-\rho} \tag{11}$$

and equilibrium share prices satisfy (8), that is when

$$V_1^j = \beta\left(\frac{d_2^A}{d_1^A}\right)^{-\rho} \sum_{i=g,b} \pi^i d_2^{ji} = \beta\left(\frac{d_2^A}{d_1^A}\right)^{-\rho} E_1\left[d_2^j\right]. \tag{12}$$

As regards the first period equilibrium allocation, when (11) and (12) hold, the intertemporal utility of country j's investors is maximized under the date 1 budget constraint (3): country j's investors consume a fraction μ^j of world tradable output, purchase the same share of the global mutual fund, and choose not to hold riskless bonds.

Since countries are similar in every respect except for the realization of a date two country-specific productivity shock, home and foreign firms' market value in the first period is the same ($V_1^h = V_1^f$),

$$V_1^j = \sum_{i=g,b} \pi^i \frac{d_2^{ji}}{1+r} = \frac{1}{2(1+r)}\left(d_2^{jg} + d_2^{jb}\right) \tag{13}$$

and countries hold the same proportion of the global (tradable) mutual fund: $\mu^h = \mu^f = 1/2$. Then, equations (9) and (10) for equilibrium consumption levels of home investors' can be written as

$$C_1^{Ph} = \frac{d_1^A}{2} \quad \text{and} \quad C_2^{Ph} = \frac{d_2^A}{2}. \tag{14}$$

Given the perfect symmetry between the home and the foreign country, in the world economy there is no aggregate uncertainty. Omitting the country index, second period aggregate dividends can be written as

$$d_2^A = \left(d_2^g + d_2^b\right) = (1-\alpha)Y_2^A - I_2^A + Z(L_2^g - L_2^b)$$

Prices are actuarially fair, as investors in both countries by holding a well-diversified portfolio can ensure themselves the same state-independent consumption level in period two (i.e. $C_2^{Ph}(s) = \frac{d_2^A}{2}$).

Turning to labor-owners, they cannot insure against labor income risk and are constrained to consume all what they earn. Recalling equation (1), their consumption levels are $C_1^W = \alpha Y_1$ and $C_2^W = \alpha Y_2^i - Z^i L_2^i$.

Total consumption in each country is simply given by $C_t^T = C_t^W + C_t^P$. In the first period it equals $C_1^h = \frac{1}{2}(Y_1^A - I_1^A) = C_1^f$. In the second period, rearranging terms, the following equations hold

$$C_2^g = \frac{1}{2}(Y_2^A - I_2^A) + \left[\frac{1}{2}\alpha\left(Y_2^g - Y_2^b\right) - \frac{1}{2}Z(L_2^g - L_2^b)\right] \quad (15)$$

and

$$C_2^b = \frac{1}{2}(Y_2^A - I_2^A) - \left[\frac{1}{2}\alpha\left(Y_2^g - Y_2^b\right) - \frac{1}{2}Z(L_2^g - L_2^b)\right]. \quad (16)$$

In the presence of undiversifiable risk components, national consumption streams differ across states of nature. Equations (15) and (16) suggest that some caution is needed when observing aggregate data: the country-specific shock component which cannot be diversified on financial markets nor via national institutions can be hardly detected when workers and investors' consumption streams are merged. Actually, it coincides not with the expression in square-brackets in (15) and (16), but with the share of internationally uninsurable fluctuations of labor-incomes $\frac{1}{2}\alpha\left(Y_2^g - Y_2^b\right)$ not smoothed out by within-country risk-reallocation. Labor market institutions provide some degree of country-specific non-market insurance $Z^i L_2^i$. The idea that the higher the adjustment cost the smaller the response of aggregate consumption to income shocks finds empirical support in Lo Prete (2013), who shows that, across OECD countries, the stringency of employment protection legislation plays an important role in dampening consumption fluctuations.

4.2. Consumption and capital flow volatility

With respect to what would happen in a free market economy, the amount of undiversifiable risk borne by labor-income owners decreases by $Z^i L_2^i$, and labor income and consumption end-up relatively "stabilized". The volatility of investors' consumption, instead, is higher, because capital incomes, while still perfectly diversified across countries as they were under complete markets, bear the burden of within-country risk-reallocation, which amounts to $Z\left(L_2^g - L_2^b\right)$.

As regards capital income flows volatility, the following analysis investigates the effect of the interaction between labor market institutions and productivity shocks on inter-temporal and intra-period asset trade. A useful tool to track trade over time is the current account balance, which accounts for the change in the value of a country's net claims on income from the rest of the world (i.e. the change in a country's net foreign assets), and reads:

$$CA_t^h = Y_t^{hi} - I_t - C_t^{hi} + \left(x_{ft}^h d_t^f - x_{ht}^f d_t^h\right)$$

where $x_{ft}^h d_t^f$ ($x_{ht}^f d_t^h$) represents the amount of foreign (home) period t dividends owned by home (foreign) investors, that is, dividend payments from abroad. In the present framework, the current account balance is determined by consumption and investment out of tradable capital-income only. Trivially, it equals zero in both periods:

$$\begin{aligned} CA_1^h &= Y_1^{Ph} - I_1 - \frac{d_1^A}{2} = 0 \text{ and} \\ CA_2^h &= Y_t^{Phi} - I_2 - \frac{d_2^A}{2} + \left(\frac{1}{2} d_2^f - \frac{1}{2} d_2^h\right). \end{aligned} \tag{17}$$

Since investors diversify away all the country-specific dividend-income risk by trading state-contingent assets, there is no intertemporal trade.[4]

To explore the effects of risk-reallocation in terms of capital income inflows/outflows, define the capital income flow balance as a country's net capital income inflows from abroad,

$$F_t = C_t^{ji} + I_t - Y_t^i.$$

The expression above represents intra-period capital income movements, and focuses on the amount of resources flowing into or out of domestic borders regardless of whether they are domestically or foreignly owned.[5] In the first period, investors in both countries own all the claims on domestic firms' dividends and there are no capital income outflows/inflows (i.e. $F_1 = 0$). In period two, state-contingent national consumption levels

[4] Viewed from another perspective, the current account balance equals domestic savings minus domestic investment. Net savings in the home country are given by purchases of foreign assets $V_1^f x_{f2}^h$, minus sales of domestic assets $V_1^h\left(1 - x_{h2}^h\right)$. Provided that in equilibrium $x_{f2}^h = \mu^h$ and $V_1^h = V_1^f$, the same results in (17) hold and $CA_1^j = \left(\frac{V_1^f}{2} - \frac{V_1^h}{2}\right) = 0$.

[5] The a definition of capital income flows used in this paper considers quantities in "domestic" rather than "national" terms, as, for instance, in Bertola and Drazen (1994).

are given by (15) and (16); omitting the j index and recalling that $Y_2^A = \left(Y_2^g + Y_2^b\right)$, capital income flows in a good state are

$$F_2^g = \frac{1}{2}\left[(Y_2^A - I_2^A) + \alpha\left(Y_2^g - Y_2^b\right) - Z(L_2^g - L_2^b)\right] + I_2 - Y_2^g$$
$$= -\frac{1}{2}(1-\alpha)\left(Y_2^g - Y_2^b\right) - \frac{1}{2}Z(L_2^g - L_2^b)$$

and, in a bad state,

$$F_2^b = \frac{1}{2}\left[(Y_2^A - I_2^A) - \alpha\left(Y_2^g - Y_2^b\right) + Z(L_2^g - L_2^b)\right] + I_2 - Y_2^b$$
$$= -\frac{1}{2}(1-\alpha)\left(Y_2^g - Y_2^b\right) + \frac{1}{2}Z(L_2^g - L_2^b)$$

These equations show that, when a positive (negative) shock hits the country, capital flows out of (into) the country by an amount which is greater than the value of the original country-specific productivity shock's component which can be internationally traded, that is, they are greater than $\frac{1}{2}(1-\alpha)\left(Y_2^g - Y_2^b\right)$.

In summary, in the presence of labor market institutions some risk is shifted from workers to investors by allocating an additional risk component on incomes earned by capital. The volatility of labor incomes decreases at the expense of greater fluctuations in capital incomes, and the effect of the country-specific shock on capital flow volatility is amplified by a factor equal to the amount of income which crosses national borders as a consequence of the world-wide pooling of the additional risk component represented by $\frac{1}{2}Z(L_2^g - L_2^b)$. The model, by explicitly accounting for national risk-shifting arrangements and their effects on capital flows, provides a realistic theoretical foundation for the idea, first outlined by Bertola and Drazen (1994), that government policies may amplify the effects of original exogenous uncertainty on capital incomes and, hence, affect capital income flow volatility.

5. Heterogeneous institutional frameworks

In what follows, the model is extended to study the behavior of labor and capital incomes when the world economy consists of two countries that have different institutional settings. Without loss of generality, the analysis will be kept as simple as possible, since allowing for heterogeneity in the structure of national labor markets may involve considerations on productive efficiency whose discussion goes far beyond the scope of the present paper.

Let the home country display the labor market structure modeled in Section 2, while the foreign country is a free-market economy, i.e. $Z^h \neq Z^f = 0$. Assuming that countries own a constant share of world tradable income (μ^j), the present discounted value of future uncertain dividends will be the same in the two countries (i.e. $V_1^h = V_1^f$), and equilibrium allocation problems will be easily solved as in Section 4. Investors will hold a fraction $\mu^h = \mu^f = 1/2$ of the world tradable mutual fund, their consumption level will be given by equation (14), and firms' investment decisions will still imply $I_t^h = I_t^f$. For the equality $V_1^h = V_1^f$ to be true, simplify the market discounted factor and investment on both sides of equation (13). Then, the following condition must hold:

$$\frac{1}{2}\left[(1-\alpha)\left(Y_2^{hg} + Y_2^{hb}\right) + Z^h(L_2^{hg} - L_2^{hb})\right] = \frac{1}{2}(1-\alpha)\left(Y_2^{fg} + Y_2^{fb}\right).$$

The equation above imposes constraints on the size of the impact of second-period productivity shocks in the two economies, by introducing a compensating asymmetry whereby $Y_2^{hg} + Y_2^{hb} < Y_2^{fg} + Y_2^{fb}$.

This modeling strategy yields useful insights about investors' risk-sharing opportunities in presence of heterogeneous institutional settings. Unlike the case of homogeneous institutional frameworks, it can be shown that when risk-reallocation margins differ across countries the world economy exhibits aggregate tradable income's uncertainty. Denoting with s^1 (s^2) the state of the world economy whereby business conditions turn good (bad) in the home country, and bad (good) in the foreign country, aggregate world-wide dividends in the two possible states of nature are

$$d_2^A(s^1) = \left(d_2^{hg} + d_2^{fb}\right) \neq d_2^A(s^2) = \left(d_2^{hb} + d_2^{fg}\right).$$

Since aggregate dividends differ across world-wide states of nature, investors in both countries, even by holding a well-diversified portfolio, will absorb the risk due to systematic aggregate tradable wealth's uncertainty. Capital owners cannot benefit from a state-independent consumption level in period two anymore, because

$$C_2^{Pj}(s^1) = \frac{1}{2}\left[(1-\alpha)Y_2^A - I_2^A + ZL_2^{hg}\right] \neq \frac{1}{2}\left[(1-\alpha)Y_2^A - I_2^A - ZL_2^{hb}\right] = C_2^{Pj}(s^2).$$

With such heterogeneous institutional frameworks consumption out of capital incomes ends-up more volatile with respect to the case of homogeneous institutional settings if business conditions turn good (i.e. if s^1), and less volatile if business conditions turn bad (i.e. if s^2).

Hence, investors who access world financial markets, even by perfectly diversifying their portfolios, will bear the burden of heterogeneous risk-reallocation policies in terms of second-period tradable output's aggregate uncertainty. As concerns labor-income volatility, consumption streams trivially fluctuate less in the home country, where workers benefit of risk-reallocation provisions, than in the foreign *laissez faire* economy.

6. Concluding remarks

This paper shows in a stylized model that employment protection legislation affects the transmission of country-specific income shocks and the behavior of consumption and capital income flows by redistributing risk among agent types within country borders.

The theoretical analysis proposed uncovers a novel mechanism whereby institutional features of national labor markets may be relevant to macroeconomic outcomes, in a simple yet consistent with the evidence framework, paving the way for further theoretical and empirical work in both international and labor economics. The model could be extended to study the effect of asymmetries in adjustment costs and the relevant trade-offs between labor income insurance and production efficiency, as well as to focus on business cycle fluctuations and to perform simulation analyses as in Zanetti (2011). Along another line of future research, it would also be interesting to consider institutional features other than employment protection legislation, as of course institutions interact among themselves in many and possibly relevant ways, generating policy complementarities amenable for further investigation.

From an empirical point of view, the effect of labor markets as institutional devices able to shift risk within country borders has proved to be relevant to the way aggregate consumption responds to idiosyncratic income shocks in Lo Prete (2013). The present analysis may complement this and other existing studies on macroeconomic puzzling evidence. For instance, in a model where agents own both capital and labor, institutionally-provided within-country risk-reallocation might help explain why in most OECD countries there exists a negative correlation between wages and profits independent of business cycle fluctuations as found by Bottazzi et al. (1996). This paper could also provide some theoretical background for the empirical analysis by Fidrmuc et al. (2011), who suggested that FDI and employment protection legislation may increase cross-country risk sharing by fostering bilateral consumption correlations. In future work,

attention could be devoted to testing the model's predictions about the effects of institutions on the volatility of capital income flows too, bringing to the data some insights first highlighted by Bertola and Drazen (1994).

From a normative point of view, the analysis in the present paper suggests that national labor market reforms and policies need to be carefully addressed, as they affect risk-sharing opportunities available to agents who likely do not access financial markets easily, and, in turn, affect capital income flows. If somehow neglected over the past decades, understanding the interactions between national institutions and macroeconomic outcomes across countries has become a demanding issue in a world where, as the recent financial and economic crises have shown, public policies may be called to substitute financial markets when they do not function well (Bertola and Lo Prete, 2013).

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Figure 1. Adjustment costs and risk reallocation