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Estimating the Gains from International Diversification

The Case of Pension Funds

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Abstract

For pension funds, international assets represent an opportunity to improve their returns while possibly reducing risks. Nonetheless, pension funds in many developing countries face regulations that limit the choice of international investments. This paper proposes a new methodology to estimate the gains from international diversification in which the optimal asset allocation of pension funds is constrained by financial frictions. The empirical strategy is applied to the aggregate holdings of pension funds in a large group of countries to calculate the gains from increasing the current level of exposure to international securities. The methodology should give policy makers the opportunity to identify jurisdictions where pension funds could benefit the most from expanding their foreign holdings.

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Estimating the Gains from International Diversification: The Case of PensionFunds

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1. Introduction

What is the appropriate asset allocation between domestic and foreign securities for pension funds? Increased access to financial markets across the globe has provided expanding opportunities for individuals and institutional investors to diversify their portfolios. While it has been widely recognized that cross-border diversification offers significant advantages,[4] there is ample evidence that most investors do not exploit such opportunities, as they allocate a relatively large fraction of their wealth to domestic securities; the so-called "home bias."[5] According to the Capital Asset Pricing Model (CAPM), the workhorse of modern portfolio theory, holding of foreign assets should be inversely proportional to the size of the domestic market in the world portfolio. Since developing countries represent only a small fraction of the world's market capitalization, the optimal allocation of domestic investors in these countries should be largely skewed towards foreign assets; up to 100% of portfolio investments exclusively in foreign assets. For pension funds, such extreme allocations are likely unfeasible or impractical,[6] whether the country's pension system is defined-benefit or defined-contribution, centrally or individually managed, publicly or privately managed, mandatory or voluntary. To the extent that estimates of the benefits of international diversification are calculated relative to the theoretical prescription of the CAPM, such gains might be either misleading or largely exaggerated. To promote useful policy actions in these countries, one needs proper estimates of the benefits from increasing the exposure to international securities.

[4] For example, see Grubel (1968), Levy and Sarnat (1970), Solnik (1974), Grauer and Hakansson (1987), Eldor, Pines, and Schwartz (1988), DeSantis and Gerard (1997), among many others.
[5] Home bias in portfolio holdings has been documented for mutual funds (Chan et al., 2005), individual investors (Lewis, 1999), and in both high income and developing countries (Pedraza et al. 2019).
[6] One reason for this impracticality may be the exclusion from this analysis of any non-financial returns associated with domestic investment, such as the promotion of domestic social goals.

In this paper, we propose a new methodology to estimate the gains from international diversification in which the optimal asset allocation of pension funds is constrained by financial frictions. We apply our empirical strategy to the aggregate holdings of pension funds in a group of 49 countries (19 developed and 30 developing) to calculate the gains from increasing the current (or last reported) level of exposure to international securities.

The intuition of our strategy can be explained as follows: Using the asset allocation of pension funds between 2002 and 2019 for a group of 77 countries, we estimate as a benchmark the "natural" level of foreign exposure, that is, the expected level of foreign holdings for pension funds operating in a country with a particular level of financial market development, integration to international markets, and where the pension system characteristics, such as its total size, size of contributions among other observables, are considered. Notably, the benchmark rate is not a first best (optimal) allocation – specifically, it is not normative. Instead, it might be interpreted as a peer benchmark, providing a pragmatic view of what is possible elsewhere. We then use portfolio optimization techniques to calculate the maximum gains that a pension fund operating in a given country can achieve if it increases its level of foreign exposure to the benchmark rate. We refer to this analysis as the constrained optimization problem and compare the findings to a setting where financial frictions play no role. The latter case denotes the scenario where pension funds can achieve the maximum allocation suggested by standalone portfolio optimization.

To be more precise, we use the latest reported portfolio holdings in domestic equity, domestic debt, foreign equity and foreign debt, by all the pension funds operating in a specific country. Following the well-known approach of Black and Litterman (1992), we estimate the expected returns and risk (i.e. standard deviation of returns) of an investor domiciled in the country with unhedged foreign positions. We then estimate the maximum expected returns if the investor increases her foreign assets to the benchmark rate, maintaining the current level of risk. The increase in returns are precisely the gains from augmenting the foreign exposure to the natural level that is given by macro and financial variables. Overall, the analysis presented in this paper

can be applied to any pension system, public or private, that is not purely pay-as-you-go.

We find that the potential gains from increasing the foreign holdings in pension systems under the benchmark rate are similar for both high-income and developing countries; 0.08% of additional returns per month or close to 1.00% per year. Although such gains appear to be modest at first glance, over a 40-year accumulation timeframe for a pension fund the compounded impact of such an increase is powerful. Further, there are significant variation across countries. For example, among developing countries, pension funds in Brazil, Indonesia, Kenya, Thailand, and Turkey could increase their expected returns by over 150 basis points per year if they were to reach their respective benchmark level of foreign holdings. This level of prospective improvement in average annual returns would provide very significant benefit for the pension funds in these countries. As in many parts of the world, some of these same countries are experiencing rapid aging across broad segments of the population and their funded pension systems are not producing the level of returns needed to provide an adequate level of retirement income in future years. The combination of rapid aging and scheme inadequacy is an emerging crisis for funded pension systems. This opportunity of increased returns could aid not only private funded pension systems but funded portions of public systems that will bear even more of the burden of rapid aging and system inadequacy.

We also use our methodology to examine the evolution of foreign holdings over time and the gains or losses from changes in international securities in the pension funds' portfolios. For instance, in Mexico, up until 2013, the international allocation of pension funds was mostly in line with the estimated natural rate of foreign exposure (as the pension system based on defined-contributions and individual capitalization accounts matured, so did the portfolios' exposure to international securities). After 2013, there were no further increases in the relative exposure to foreign assets. According to our estimates, the lack of further growth in the share of foreign assets represented a loss in the expected forward-looking returns of over 90 basis points per year in the next six years. While quantitative limits on foreign assets were not binding during these years (set at 20% by local authorities), lack of access to international mutual funds due to regulatory

restrictions appear to have discouraged management companies to further boost their participation in international markets, due to the added costs of direct foreign holdings.

Overall, our methodology provides a simple measure to compare across countries, evaluate current limits on foreign securities, and examine the dynamical allocation of pension funds to foreign assets.

The rest of the paper is organized as follows. In section 2, we review the literature that presents the common arguments in favor and against international diversification by pension funds. Section 3 describes the data used in the analysis. In Section 4, we examine how foreign holdings of pension funds have evolved over time and estimate the benchmark rate of foreign holdings. Section 5 presents our empirical methodology and main findings. Section 6 concludes.

2. Pension systems and the case for international diversification

There are several explanations for the existence of home bias in portfolio investments. These include: (i) hedging motives in frictionless financial markets, that is, real exchange rate and non-tradable income risk (Stockman and Dellas, 1989; Wheatley, 2001), (ii) higher asset trade costs in foreign markets (such as transaction costs, differences in tax treatments between national and foreign assets or differences in legal frameworks), (iii) informational frictions (Brenan and Cao, 1999; Portes and Rey, 2005; Leuz et al., 2010; Pedraza et al., 2020) and (iv) behavioral biases (Bailey et al., 2011; Riff and Yagil, 2016). While disentangling the contribution of each motive on the bias towards domestic assets is difficult, it is well-known that portfolio investments in foreign markets are influenced by market development in both the source and target countries, by investor familiarity with each market as suggested by common language, bilateral trade flows, and both geographic and cultural proximity (Chan et al, 2005). Such factors could be viewed as proxies for a behavioral bias toward familiar investments, but these might also operate as proxies for market access, information asymmetries, and market imperfections (Froot and Ramadorai, 2008; Aluquerque et al., 2009).

In addition to the above explanations for home bias in the investment literature, pension funds often face other restrictions that limit the amount of international assets in their portfolios (Raddatz et al., 2013; Pedraza, 2015). The public or mandatory nature of these funds often promotes a regulatory framework that constrains the exposure to foreign securities (Morales et al., 2017). Quantitative restrictions are used to limit the amount of international investments with the general idea that other assets perceived to be less risky will better protect the pensions of their participants, but there are also additional arguments that might call for stringent limits on international securities. First, policy makers might desire to keep domestic savings invested in the home country to support local development goals. If the social return of domestic investments is higher than the private returns of pension funds, the state would aim to target higher levels of home bias. Such argument, however, requires the presence of additional market frictions. For instance, when market integration is low, it might be more expensive to raise funds from international investors than from domestic ones, generating a wedge between domestic and foreign sources of financing (Menil 2005). While this goal might be well-intentioned, it usually involves a subordination of the welfare of pensioners in favor of a domestic development goal in the situation where the two goals are at odds. These same pensioners may be helped indirectly by such domestic development, but they would be disproportionately bearing the cost for it.

Second, if hedging currency risk is expensive, then the currency denomination of the liabilities becomes important. All else equal, having large domestic currency liabilities (as the pension funds do) would argue for positive home bias. Another reason behind reluctance to allow non-domestic investment is a desire to avoid currency exchange rate volatility within the investment portfolio (Thomas et al., 2014). The logic behind this reasoning is that the ultimate pension liability will be in domestic currency, so the investments ought to similarly be priced in domestic instruments. However, some investments (as an example, equity over the long term) may even benefit from the dynamics of foreign exchange volatility when considered holistically as part

of the broader volatility of these investments over many years. Further, many domestic equity markets are overly concentrated (i.e., few issuers in a small group of industries), and the inclusion of non-domestic holdings may allow much broader sectoral diversification that more than offsets the near-term currency mismatch (Cetorelli et al., 2007).

Finally, differences in risk perception between domestic and foreign assets, especially between domestic and foreign government bonds, can significantly affect the portfolio allocation. For instance, while fixed rate bonds issued by the sovereign are subject to interest rate risk and default risk, from the point of view of a domestic pension fund, the default risk might be negligible. The argument is that a default by the sovereign is often preceded or accompanied by a takeover of the pension system. In other words, from the perspective of the domestic fund, rather that realizing losses from a default by the local government, a default would entail an absorbing state in which the private pension industry is nationalized. For any other investor (e.g., a foreign investor), the default probability implies a potential loss. Such difference in risk perception creates a gap between the holdings of domestic vis-à-vis foreign pension funds, generating a rational overweighting of domestic government bonds for the former group. As part of this final point, it is worth mentioning that absolute levels of interest rates for domestic government bonds likely also play a role in willingness of the domestic market to diversify; with those markets enjoying relatively high rates usually less willing to enact such a change.

In contrast to the arguments against international diversification for pension fund assets, the portfolio selection theory has shown extensive evidence that portfolio risk can be reduced significantly by investing in international stocks (Solnik, 1995), and has documented that global portfolios provide a substantial risk-return improvement (Michaud et al. 1996; Laster 1998; Clarke and Tullis 1999; Grinblatt and Keloharju 2001). Importantly, in developing countries where the domestic financial sector might be too small, local markets might not provide the amount of financial assets required by rapidly growing pension funds (Chan-Lau, 2005). To the extent that

some pension funds are large relative to their domestic financial markets, an over-reliance on local assets could distort asset prices, as allowable domestic securities in the pension portfolio would experience abnormal demand (Pedraza & Pulga, 2019). Moreover, ownership concentration is often associated with low trading activity in secondary markets and to mispricing (Leaño & Pedraza, 2018; Pedraza, 2019).

Finally, the recent COVID-19 shock has brought to the forefront the importance of international diversification due to liquidity motives. There is anecdotal evidence that pension funds in Chile, Colombia, and Peru disproportionally sold foreign securities to meet (expected) sudden withdrawal demand from account holders or to meet collateral requirements in derivative holdings. Such access to liquidity would have been prohibitively expensive in their relatively small domestic markets.[7] An increasing concern also related to COVID-19, however, is that that domestic

[7] Documented from interviews with local authorities in these countries and with fund managers.

pension funds may be targeted by authorities to finance increasing levels of public debt. Policy makers in countries with little fiscal space might promote home bias to support increased public assistance spending resulting from the COVID-19 lockdowns (Stewart, Davis & Knaack 2021 forthcoming).

In line with arguments in favor of international diversification, foreign exposure of pension funds has increased over the last two decades, from 16% of assets in 2002, to 36% by the end of 2019 (data and details in Section 3). However, such systematic increase in international exposure has been uneven, with pension funds in many countries displaying little or no change. Taken as a whole, whether through regulatory imperative or behavioral tendencies to avoid international investment, many pension funds around the world are delivering less than their full potential and exhibiting much higher volatility than necessary given their lack of international diversification. This is occurring despite what is generally a building crisis in adequate pension provision in many countries –mainly due to the rapid aging happening across the world, coupled with what have been some unsustainable parametric design features for existing schemes. Given the magnitude of this unfolding dilemma, it will be important for funds to consider better incorporating the benefits of international diversification and regulators to reconsider restrictions that have shortchanged many systems at the likely future cost to their members.

Most of the financial literature investigating home bias takes the perspective of a US investor. Research on home bias outside of the US is scarce and, if available, does not explain the dynamics of home bias in mature markets. Because the gains from international diversification vary considerably across markets, there is room to study home bias in other markets. In this sense, the pension industry offers an invaluable opportunity to further explore the determinants of home bias. The availability of multi-asset data in many pension jurisdictions with a sufficiently long horizon provides the opportunity to study the cross-sectional variation in domestic bias in the

portfolio choices of institutional investors over time and across asset classes.

3. Data

We use data from two main sources. First, we use information from the Global Pension Statistics Project administered by the OECD which covers funded and private pensions components of pension systems across the world. Between 2002 to 2019, the data set provides country-year coverage of pension assets, including data on domestic and international holdings disaggregated by asset class (e.g., equity vs. fixed income assets). In recent years, the GPS data set has added new countries to its coverage. We use an unbalanced panel of 77 countries for a total of 853 country-year pairs. Second, we collect country data on financial and economic development from the World Development Indicators (WDI). We use information on financial integration, measured as foreign direct investment inflows, currency account, and the existence of a common currency (e.g., for euro zone countries). Other variables capture capital market development, such as the total market capitalization of the domestic stock market and trading volume, as well as economic development, including GDP per capita and GDP growth (Table A.1 includes a list of countries and summary statistics for each variable).[8]

[8] We also collect, for a subsample of countries in Latin America –Chile, Colombia, and Peru – detailed portfolio information from local pension supervisory authorities. The data set includes comprehensive security-level information covering the entire portfolio composition of pension funds in these countries. The data set is useful as it provides a clear picture of the type of assets that pension fund managers are using to access international markets, and to compare how these relate to domestic security selection.

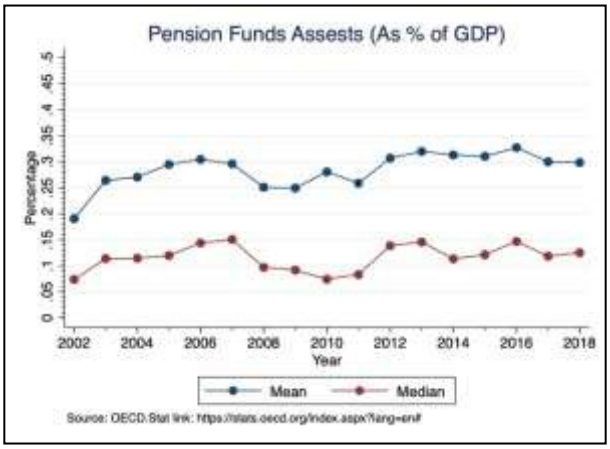
4. International allocation of pension funds

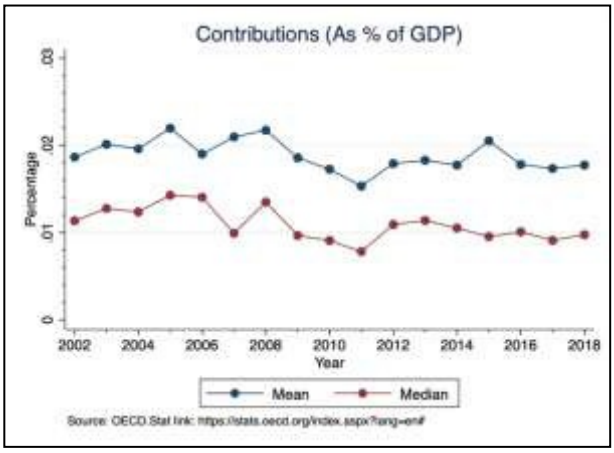
Pension assets are a large component of global capital markets and have grown in size over the last two decades (Figure 1). Although total pension assets reached $48.1 trillion at the end of 2019, the growth has not been constant over time and it has been mostly uneven across countries. For example, while pension contributions peaked in 2005, these declined after the 2008 Global Financial Crisis (GFC) and have not reached pre-crisis levels since (Figure 2). Following the drop in contributions, and exacerbated by lower portfolio valuations during the GFC, pension assets experienced a decline in size relative to global GDP between 2008 and 2011. After 2012, global pension assets experienced modest growth, rising from 25% to 30% of GDP at the end of 2019.

According to the OECD Global Pension Statistics, during the last 20 years, pension funds across the world have significantly increased their share in foreign holdings. In 2002, pension funds had 16% of their portfolio allocated to international investments. Foreign exposurerose consistently in the next two decades, reaching 36% of total assets by 2019 (Figure 3). Although the level and pace at which pension funds have increased their foreign assets vary acrossregions, the data suggests that over time, pension funds systematically gain exposure to international assets (see Figure 4). For example, while pension funds in ECA and MENA countrieshad almost no foreign exposure in 2002, the share of foreign assets grew to 11% and 20% respectively by 2019. We find similar patterns in Latin America, Western Europe and East Asia and Pacific regions.

Figure 1. Pension assets

Figure 2. Pension funds' contributions

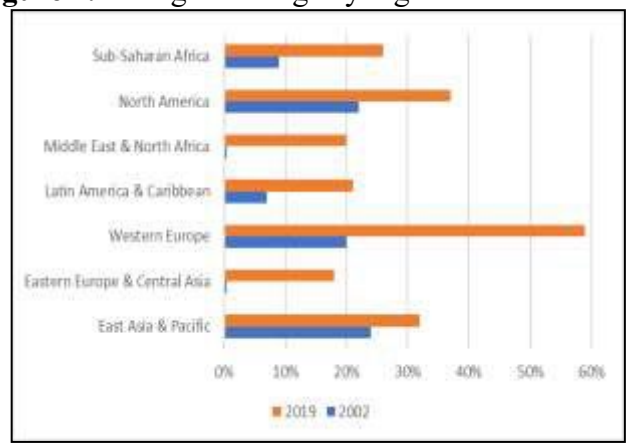




Source: OECD.

Figure 3. Foreign holdings of pension funds

Figure 4. Foreign holdings by region



Source: OECD.

An alternative way to examine the foreign exposure is to look at international holdings relative to the year of previous major pension reform. While comparing pension foreign holdings across country by calendar year has the advantage of relating the evidence to global events, it has the disadvantage that it effectively compares pension systems under different development stages. For example, by 2002, the Chilean pension system based on defined contributions and individual capitalization accounts had been in existence for 20 years. That same year, other pension systems based on Chilean-like reforms were only starting to appear in Eastern Europe, and for most countries in Latin America, they were in operation for less than a decade. To account for the level of 'maturity' of each pension system, we plot the share of foreign holdings relative to the years in

operation for a sample of 15 countries operating DC pension schemes.[9]

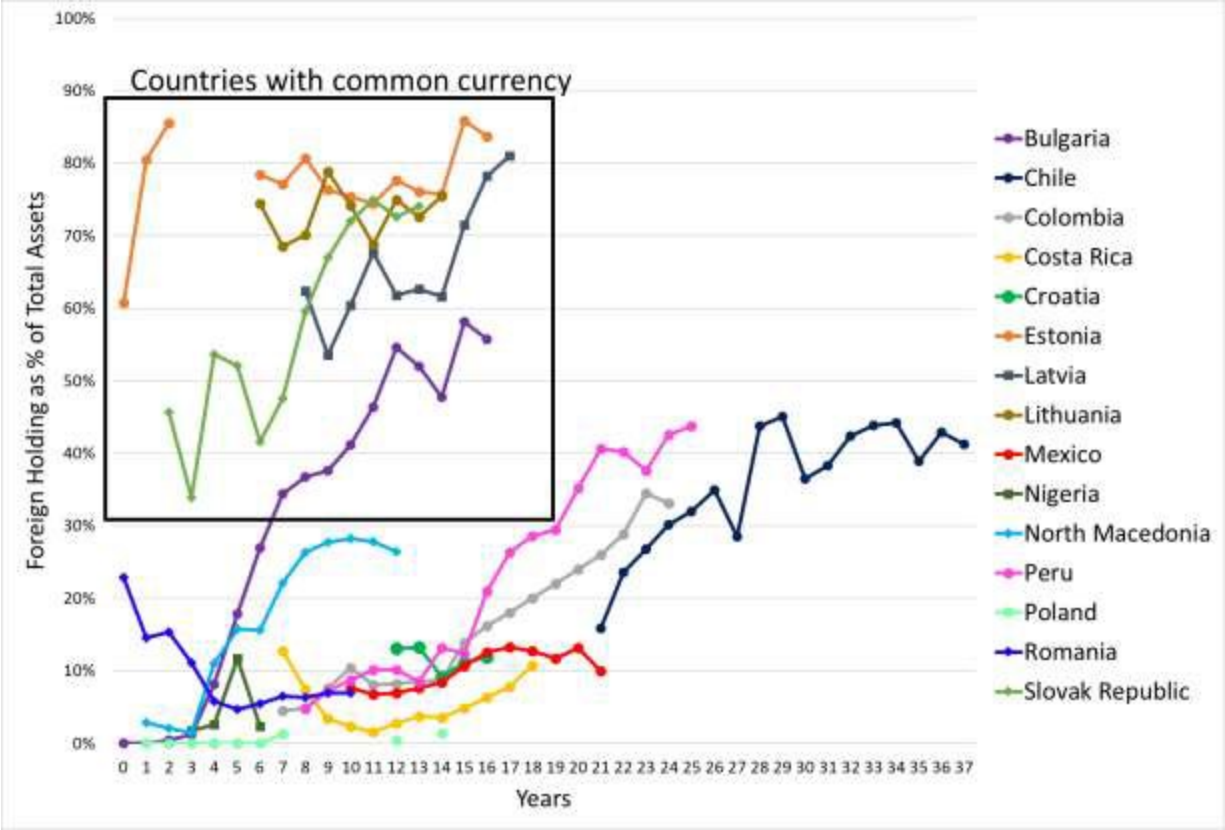
Figure 5 provides two sets of related evidence. First, consistent with the overall sample, as pension funds are more established and their assets grow, they increase their international holdings over time. The pattern is interesting because it reveals a natural convergence towards foreign assets that depends on the development stage of each system. For instance, by 2019, the share of foreign assets of Colombian pensions was 33%. While this is significantly smaller than Chilean pension funds in that same year (42% of foreign holdings), the benchmark in the region, the Colombian number is actually above that of Chile if we count from the first year of operation of the system (24 years since the introduction). Importantly, such analysis is useful because it allows us to identify countries with pension assets are under the trend even after controlling for maturity. For instance, within Latin America, Mexico lags its peer countries in foreign exposure with 10% of assets in its 21st year of operation.

Figure 5 also provides a clear distinction between the levels of foreign holdings across countries. In the upper section of the figure (highlighted in a box) are countries under common currency regimes. In these countries, pension funds allocate a large fraction of their portfolio to non-domestic assets. For example, pension funds in the Slovak Republic, where the euro has been the official currency since 2009, hold more than 50% of their assets in foreign securities during most years in the sample. On the contrary, in countries without common currency regimes, such as Romania, Costa Rica, Mexico, Peru, Chile, and Colombia, foreign holdings are significantly

[9] These countries are Bulgaria, Chile, Colombia, Costa Rica, Croatia, Estonia, Latvia, Lithuania, Mexico, Nigeria, North Macedonia, Peru, Poland, Romania, and Slovak Republic.

lower. The evidence is consistent with the idea that to the extent that hedging currency risk is expensive, as is the case in non-common currency countries, home bias tends to be more predominant. Presumably, currency hedging might improve with financial market development when derivative securities become widely available.

Figure 5. Foreign holdings relative to the first year of operations



Source: OECD and FIAP.

What are the determinants of international diversification? So far, we document that fund size, common currency regimes, and system maturity can play a natural role in the way fund managers access foreign markets. To evaluate the role of additional drivers of foreign holdings we perform two empirical exercises. First, in Table 1, we present the average of foreign holdings across funds in different countries sorted by different economic variables. To be precise, we group countries by quartiles of each variable of interest (e.g., stock market capitalization) and calculate the average share of foreign assets for pension funds in each group. The first (last) quartile

represents countries in which the variable takes the lowest (highest) values. Consistent with previous findings, foreign holdings by pension funds are larger in countries where cumulative assets represent a greater share of GDP, where yearly contributions are a higher share of GDP, and in countries with common currency regimes. For example, while foreign holdings account for 21% of total assets in countries with the lowest level of yearly contributions (quartile 1), in countries where contributions are the highest, foreign holdings are on average 37% of the pension portfolio.

Table 1. Average of foreign holdings sorted by variables of interest

	Foreign Holdings (Average)			
	Q1	**Q2**	**Q3**	**Q4**
Pension Funds' Assets as % of GDP	17%	29%	26%	31%
Contribution as % of GDP	21%	25%	24%	37%
Common Currency	15%			60%
Current Account as % of GDP	21%	22%	30%	28%
FDI as % of GDP	25%	21%	26%	29%
GDP Growth as % of GDP	25%	29%	26%	20%
Market Capitalization as % of GDP	18%	19%	24%	24%
Stocks Traded (Value) as % of GDP	19%	16%	20%	25%
Portfolio equity, net inflows (current US)	25%	27%	22%	27%
Bills and Bonds as % of Total Assets	34%	34%	26%	11%
Short Term Assets as % of Total Assets	23%	26%	27%	30%
Mutual Funds Assets as % of Total Assets	8%	17%	32%	44%

Source: OECD and WDI. Authors' calculations.

The results have several potential explanations. On the one hand, it is possible that when pension portfolios become large, as inflows from new contributions drive asset accumulation, they grow too large relative to domestic financial markets; in effect domestic opportunities are insufficient. Large institutional investors often also face disproportional transactions costs, particularly those that operate in illiquid markets. In such cases, in order to mitigate the negative price-impact from portfolio transactions in local securities, fund managers are 'pushed' to accommodate inflows towards foreign assets, potentially into more liquid markets. At the same time, it is possible that the positive correlation between the size of contributions and foreign holdings is spurious. For example, if countries with more developed financial systems have a higher savings rate, a larger exposure to foreign assets may arise because of the availability of

securities that provide foreign currency hedging, mitigating the exchange rate risk derived from international holdings. To evaluate the correlation between contributions, fund size, and other related variables with the share of foreign investments, we perform a parametric analysis as follows.

We estimate the share of foreign assets $y_{c,t}$ in country c in year t as follows:

$$y_{c,t} = \alpha_c + \delta_t + \gamma X_{c,t} + \lambda F_{c,t} + \varepsilon_{c,t} \quad (1)$$

where the vector of controls $X_{c,t}$ includes measures of economic development (GDP growth and GDP per capita), financial integration (foreign direct investment flows, current account balance, and a common currency identifier), and stock market development (market capitalization and trading volume). Following our previous discussion, and to capture potential variation in levels given the different cohorts in which different pension reforms were introduced, we include country-fixed effects α_c. Also, to account for systematic shocks in different years of the sample, such as the GFC, we add year-fixed effects.

Our methodology examines the extent to which different characteristics of the pension industry $F_{c,t}$ are related to foreign holdings, once we control for other observables in the country. In addition to including pension fund size relative to the domestic economy and the yearly level of contributions in $F_{c,t}$, we include the explicit regulatory limit (if applicable) of foreign holdingsfor each country-year pair. The variable takes values between 0 and 1 capturing the maximum allowed level of foreign exposure set by local by regulatory authorities.

The variables that capture financial integration explain most of the variation in the share of foreign holdings ($R^2 = 0.52$). In particular, pension funds in countries with common currency have on average 37% more foreign holdings than other pension funds. The three variables that capture pension fund characteristics explain 27% of the variation in foreign assets. As expected, countries where regulatory authorities set a higher limit in foreign exposure do in fact maintain a larger share

in foreign assets. The evidence also confirms previous findings whereas systems in which contributions represent a larger share of GDP tend to invest more actively in international markets. Interestingly, after controlling for economic development and financial integration, we find a negative correlation between the domestic market capitalization and foreign holdings. Thisfinding confirms the idea that in smaller markets, when pension assets are large relative to the domestic equity market, they tend to allocate more funds internationally.

To summarize, to the extent that pension funds are growing in size, especially in countries where the population is still young and in the accumulation stage, there is consistent growth in the share of foreign assets. Currency risks seems to be a limiting factor driving the disproportional allocation towards domestic assets. Another common driver of home bias are information asymmetries, since investors are expected to be more familiar with local conditions, and thus tend to overinvest locally. As funds grow, however, and driven by push and pull factors documented above, economies of scale imply that the average cost of information acquisition about foreign markets declines over time.

Table 2. Determinants of foreign holdings

Variable Name	Predicted Sign	Economic Development Variables		Financial Integration		Stock Market Development		Pension Funds Characteristics		All	
		Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
CONSTANT		0.530***	**(2.647)**	0.164***	**(17.07)**	0.193***	**(13.15)**	0.0132	**(0.642)**	0.545*	**(1.736)**
GDPGROWTH		-1.449***	**(-3.288)**							-0.453	**(-0.803)**
LOGGDPCONSTANT		-0.00929	**(-1.221)**							-0.0164	**(-1.456)**
FDINETINFLOWS				-0.0868	**(-0.592)**					-0.243**	**(-2.261)**
CURRENTACCOUNTB				0.125	**(1.052)**					-0.238	**(-1.474)**
CURRENCYDUMMY				0.372***	**(17.21)**					0.248***	**(7.685)**
MARKETCAP						-0.0172	**(-0.995)**			-0.0671***	**(-3.294)**
STOCKSTRADED						0.0736**	**(2.195)**			-0.0427	**(-1.186)**
LIMIT								0.292***	**(9.666)**	0.0568*	**(1.950)**
PASPGDP								0.00818	**(0.139)**	0.367***	**(5.904)**
CONTRIBUTION								2.536***	**(2.857)**	0.281	**(0.308)**
.											
Adjusted R^2		**0.097**		**0.522**		**0.113**		**0.269**		**0.648**	
Observations		474		474		315		310		184	

Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

This table reports results from panel regressions of the share of foreign pension holdings on contemporaneous variables. These variables include GDP growth rate, GDP per capita, net flows of foreign direct investments, current account balance, domestic market capitalization, trading volume (% of market cap) and a dummy that takes the value of one when the country is in a common currency regime and zero otherwise. Pension fund variables include the allowable limit of foreign holdings set by local regulatory authorities, the size of the pension portfolio (total assets/GDP) and the yearly contributions normalized by GDP. We correct for heteroskedasticity and autocorrelation in errors by using Newey and West (1987) standard errors computed with the optimal number of lags according to Newey and West (1994). Foreign holdings span the period 2002 to 2019.

5. Measuring the gains of foreign exposure

This section introduces a quantitative model of international asset allocation with financial frictions. The objective is to present a quantitative estimation of the gains from international diversification. The methodology is applied to the countries for which data have been compiled by OECD.

5.1. Model

We measure the value of global diversification as the degree to which allowing foreign assets into a portfolio raises the optimal portfolio frontier. That is, to what extent can a portfolio manager increase her expected returns for a given level of risk when more international securities are included in the portfolio.

An efficient frontier is constructed from *expected* returns and an estimate of the covariance matrix of returns. There are, however, some limitations to using this measure. First, expected returns are often proxied by realized average returns from a sample period. While such proxy is commonly used due to its simplicity and availability, it is widely known to lead to highly concentrated portfolios and input sensitivity, leading to overestimation in the gains from diversification.[10] Second, the methodology assumes that there are no extra costs to international investments; thus relaxing the constraint against foreign holdings cannot make the investor worse off.

[10] The ex post frontier derived from realized returns describes the portfolio of precisely the investor who correctly predicted the realized returns on each asset. In turn, when realized returns are used to proxy for expected returns the optimal portfolio will tilt toward those assets that generated the best opportunities in the past, largely overestimating the returns per unit of risk from holding those assets.

To deal with these concerns, we use an equilibrium concept from the international capital asset pricing model (ICAPM) to input expected returns in the construction of the efficient frontier. Furthermore, we account for potential frictions –those that might limit domestic pension fund managers from reaching the unconstrained level of international diversification– by estimating a benchmark level of foreign holdings according to each country's financial integration.

We start with the unconstrained portfolio optimization. Consider a model of portfolio choice with N assets of a pension fund located in country *c*. A number F of these are foreign assets and N-F are local. For example, the foreign assets might include fixed-income and equity securities in international markets. For each asset *i*, we estimate its beta from a regression of realized excess returns on the world portfolio returns measured in domestic currency of country *c* (i.e., from the point of view of an investor domiciled in country *c*),

$$r_{i,t,c} - rf_{t,c} = \alpha_{i,c} + \beta_{i,c}(RWP_{t,c} - rf_{t,c}) + \varepsilon_{i,t,c} \tag{2}$$

where $rf_{t,c}$ is the risk-free rate. We obtain the expected excess return on each asset by multiplying the estimated beta of the asset by the world portfolio expected excess return; or in vector notation $\pi_c = \hat{\beta}_c E[RWP_c - rf_c]$. Using the expected returns and the variance-covariance matrix of the N assets Σ, the portfolio optimization problem is simply the selection of the vector of weights w_c that maximizes the expected returns for a given level of risk. To be precise, assuming that the current asset allocation of a pension fund manager in country *c* is w_0, we want to find the portfolio that maximizes the expected returns, maintaining the variance of the current portfolio ($\sigma_0^2 = w_0' \Sigma w_0$). More formally,

$$\max_{w} w'\pi \tag{3}$$

$$\text{s.t. } w'\Sigma w = \sigma_0^2 \text{ and } 1'w = 1$$

In this mean-variance setting, the gains from international diversification can be measured in absolute terms as the difference between the expected returns of the optimal portfolio w^* and those that form the current allocation, $w^{*'}\pi - w_T'\pi$. Alternatively, we can measure the additional expected returns in units of risk $(w^{*'}\pi - w_T'\pi)/(w_T'\Sigma w_T)^{1/2}$; which represents the associated increase in the portfolio's Sharpe Ratio.

5.2. Including financial frictions

According to our discussion in the previous section, frictions which typically affect the allocation of domestic managers include information frictions, capital shortages, and portfolio adjustment costs. For instance, to the extent that national savings are small in a country that is not fully integrated with international markets, there might be a social cost from replacing the exported capital when pension funds invest abroad. Similarly, even in the case when a pension fund manager recognizes the benefits from international diversification, portfolio adjustment costs would slow the reallocation toward foreign assets. In such cases, a manager would avoid rebalancing their portfolio by selling domestic securities and thus generating a downward pressure in domestic asset prices, and instead buy new securities abroad with new contributions or from dividend payments from its investments. Portfolio 'inertia' is likely stronger in less competitive markets even if restrictions on foreign assets are lifted.

To account for the role of these financial frictions, we estimate the expected level of foreign exposure in country c in year t, $\hat{y}_{c,t}$, using the country's economic development, financial integration and pension system characteristics according to equation (1) in Section 3. That is, $\hat{y}_{c,t} = \hat{\gamma}X_{c,t} + \hat{\lambda}F_{c,t}$. We refer to $\hat{y}_{c,t}$ as the "natural" share of foreign exposure, which is the benchmark rate that we use to compare to the current level of foreign holdings. For instance, a

country with observable characteristics described by $X_{c,t}$ and $F_{c,t}$, where the total share of foreign assets in the pension's portfolio is below $\hat{\gamma}_{,t}$, is said to be underexposed to foreign assets –with foreign holdings under the natural level.

Our objective is to include a restriction based on idiosyncratic factors measured at the country level which effectively constrains the sum of foreign holdings F to that level, $\sum_{i=1}^{F} \omega_i \leq \hat{\gamma}_{,t}$. Using this additional restriction in the portfolio selection problem (equation 3),

we calculate the maximum expected returns and measure the gains relative to the current portfolio. In sum, our strategy estimates the efficient frontier when the maximum level of foreign assets is obtained from macro and financial factors in each country (e.g., size of pension industry and yearly contributions, portfolio FDI, GDP growth, common currency regime, etc.). Effectively, we are limiting the potential gains for international diversification to the benchmark level of foreign assets at any given point in time. For any point in time *T*, the step-by-step methodology is summarized as follows:

i. For each country *c* and asset *i* pair, calculate monthly returns in local currency from the first period with information t_0 up to *T-1*. That is, for $t=\{t_0, t_1, \ldots, T\text{-}1\}$
ii. For each country *c* and asset *i* pair, estimate equation (2) using the returns of the world portfolio in local currency ($RWP_{t,c}$). That is, estimate betas for each asset *s* and country *c*.
iii. Calculate the variance-covariance matrix Σ_c using local currency returns in each country
iv. Estimate expected returns using $\pi_c = \hat{\beta}_c E[RWP_c - rf]$
v. Use pension fund holdings in country *c* at time *T* to calculated current returns $w_T'\pi$ and portfolio variance $w_T'\Sigma w_T$
vi. Use portfolio maximization (equation 3) to obtain the unconstrained optimal portfolio w_T^*

vii. Calculate the benchmark share of foreign holdings for country c at time T: $\hat{y}_{,T} = \hat{X}_{c,T} + \hat{F}_{c,T}$

viii. Use portfolio maximization to obtain constrained optimal portfolio with benchmark holdings $\sum_{i=1}^{} \omega_i \leq \hat{y}_{,T} : \hat{w}_{T}$

ix. Compare gains of excess returns from current holding to constrained and unconstrained holdings.

5.3. Assets

We based our analysis on four asset classes: domestic stocks, domestic fixed income assets, world stocks, and world bonds. This will be sufficient to consider the potential role of international assets in the investment portfolio, though in reality the pension fund may have a chance to invest more broadly in assets such as real estate, infrastructure projects, corporate bonds, private equity, inflation-protected bonds, hedge funds, options, derivatives, and more narrowly defined international investments involving particular sectors or regions.[11]

Data is available through the beginning of 2020 for 49 countries, though the starting dates differ for countries, ranging from 2000 to 2010. For each country, we use the longest time period in which all the necessary data could be collected. The local bond and stock returns are calculated as the monthly percent change in local currency above the inflation rate for the major bond and equity indices respectively. Monthly excess returns are calculated relative to the domestic short-

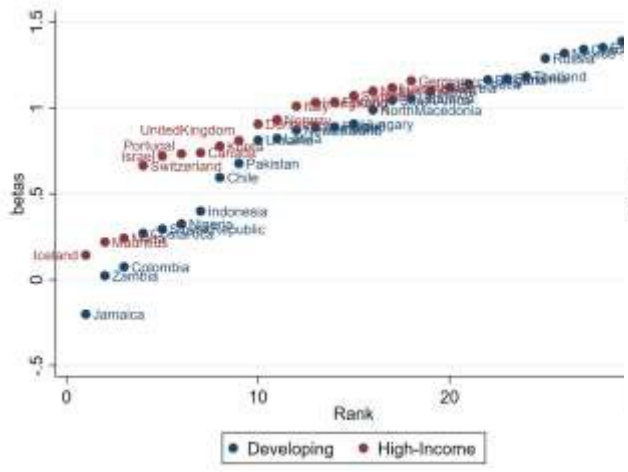
[11] For example, a potential benefit of international diversification is drawdown mitigation for the pension fund in periods when the domestic equity market is having a meltdown (which typically coincides with a real GDP crisis for the country, lower ability of the sponsors to meet pension contributions, currency depreciation, etc.). In those periods developed market assets and in particular USD denominated assets tend to outperform when translated in domestic currency terms. In such cases, there might be disproportionate benefits from having a specific type of international exposure as opposed to a generalized approach focused on global market indices. Whether such extreme scenarios would deliver more concentrated foreign holdings is left for future study.

term interest rate –either the bank deposit rate as classified by the International Monetary Fund's International Financial Statistics (IMF IFS) or the monetary authority benchmark rate reported in Bloomberg.

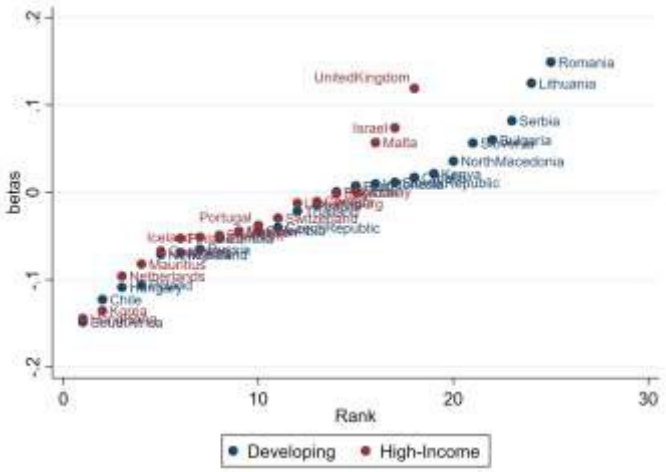
The World Market portfolio is represented by the UBS Global Securities Market Index. International bond returns and international equity returns are calculated with the S&P Global Developed Sovereign Bond Index and the S&P Global Broad Market Index (BMI) respectively. Our data represents the total returns available after coupon and dividend payments, and no administrative costs have been deducted from any of the financial assets. As for other relevant data, the exchange rate is defined as the amount of local currency that can be purchased with a unit of US dollars (USD). The exchange rate data is then used to convert the returns on the world assets into the domestic currency, so that our results are from the perspective of a local investor who does not hedge currency risk. Table A.2. presents the list of countries, the domestic equity index and summary statistics for the realized excess returns during the period. The countries in the sample include 19 high-income countries and 30 developing countries.

Figure 6. Beta of the country index return on the world portfolio calculated in local currency, 2000-2020

Panel A. Domestic Equity



Panel B. Domestic Debt



Finally, to calculate the market risk premium , $E[RWP_c - rf_c]$, we assume a constant parameter of risk aversion for all countries in our sample, $\lambda = 3$, and use the variance of the world portfolio returns σ^2=0.14% in USD such that $E[RWP_c - rf_c] = \lambda\sigma^2 = 0.41\%$. While it has been well-established that risk aversion coefficients vary across countries (Gandelman & Hernández-Murillo; 2015), from the perspective of a domestic investor, the curvature of the efficient frontier will not be affected by the estimate of the world portfolio excess return. A higher estimate will simply shift the curve upward. Since our gains from diversification are estimated in relative terms, such levels will not affect our quantitative results.

5.4 Results

Table 3 presents our main findings. For each country, the table reports the share of foreign holdings as of December 2019, the expected monthly returns and portfolio standard deviation. The table also presents the optimal unconstrained asset allocation, and the optimal allocation when the benchmark level of foreign holdings is introduced. For ease of exposition, high income and developing countries are presented separately and sorted by the potential gains from reaching the benchmark rate of international diversification.

As previously noted, by the end of the sample period, pension funds in developing countries have on average lower exposure to foreign assets – 26% of their total assets relative to 38% among high-income countries. However, according to the optimal portfolio model, pension funds in developing countries are precisely the ones that would benefit the most from increasing their international exposure. Using the estimates from the unconstrained model, a mix of 73% of assets invested in foreign equity and 11% of foreign debt securities would represent an average gain in monthly excess returns of 0.3% (5.9% per year in excess of the risk-free asset). Such gainsare up to three time larger than the potential gains of pension funds in high-income countries if

these were to reach their unconstrained level of foreign exposure: 59% in equity and 18% in debt securities. As expected, the unconstrained model generates extreme outcomes, where pension funds are better off (in risk-return terms) under exclusive foreign exposure. The outcome is most common among developing countries. For example, in Brazil, Indonesia, Thailand, Turkey, and several others, the optimal portfolio is composed by 100% investments in international stocks.

The benchmark share of foreign holdings introduces a natural upper bound to the exposure in foreign assets, anchoring the gains from international diversification. Importantly, since this benchmark is associated with variables that capture the level of financial development and financial integration, it is precisely lower for developing countries (24% on average) relative to high-income countries (39%). In practical terms, by using this natural rate we avoid generating portfolios with extreme outcomes, and the potential gains from international diversification are, in addition to being determined by the covariance structure of the assets under considerations and their expected returns, benchmarked relative to the current level of domestic market development.

According to the table, at the end of 2019, the potential gains relative to the natural rate of foreign holdings are similar for both high-income and developing countries –0.08% of excess returns per month or close to 1.00% per year. We ranked countries relative to these potential gains as of December 2019. By using the model with the benchmark holdings, we avoid holdings that might be unrealistic given the current size of the pension industry in each country. Considering the example of Costa Rica, we can read the full table as follows: By December 2019, given the actual aggregate holdings of pension funds in the country (87% in local assets and 13% of foreign holdings), the expected excess monthly returns of the portfolio are 0.08%, with an expected standard deviation of 2.1% per month. An optimal unconstrained portfolio of foreign assets would be constituted by 58.8% of international equity and no foreign debt holdings. Such portfolio is

expected to yield 0.4% returns in excess of the risk-free asset per month. In addition, the estimated benchmark level of foreign holding is 21.8%. For that ratio of foreign holdings, an optimal portfolio would yield 0.18% of returns, a net gain of 0.10% relative to the current level of holdings (1.16% per year).

Some interesting trends should be highlighted. For pension funds in Latin America, those in Brazil, Mexico, and Costa Rica would benefit the most from increasing their current levels of foreign holdings. For pension funds in Chile, Colombia, and Peru their current levels of foreign holdings appear to be in line with the optimal allocation.[12] According to our findings, several developing countries in our sample from Eastern Europe and Central Asia are under-exposed to international securities and could significantly improve their risk-return profile by increasing their foreign assets. These include Turkey, Hungary, Poland, the Russian Federation, Serbia, and Ukraine.

[12] Of note, the negative values for a few countries at the bottom of each portion of Table 3 do not indicate "too much" international diversification for those countries but rather international diversification somewhat ahead of trend. Recall the benchmark is not normative but rather based upon existing trends.

Table 3. Gains from international diversification

Country	Current holdings			Optimal portfolio					Benchmark		
	Foreign Holdings %	Expected returns	Std. Deviation	International Stocks	International Bonds	Foreign Holdings %	Expected returns	Gains (returns)	Foreign Holdings %	Expected returns	Gains (returns)
Iceland	29.0%	0.15%	2.3%	49.9%	19.2%	69.1%	0.4%	0.2%	56.3%	0.35%	0.20%
Malta	0.0%	0.10%	2.3%	68.0%	9.9%	77.9%	0.5%	0.4%	32.3%	0.30%	0.20%
United Kingdom	30.0%	0.33%	2.9%	92.1%	3.8%	95.9%	0.63%	0.3%	34.2%	0.50%	0.16%
Luxembourg	30.0%	0.37%	2.5%	73.5%	4.7%	78.1%	0.5%	0.1%	60.5%	0.48%	0.12%
Israel	20.0%	0.27%	2.7%	98.7%	0.4%	99.1%	0.6%	0.4%	27.7%	0.36%	0.09%
Germany	46.0%	0.37%	2.2%	57.5%	16.6%	74.1%	0.4%	0.1%	46.6%	0.40%	0.03%
Canada	37.0%	0.29%	1.6%	39.1%	13.7%	52.8%	0.3%	0.0%	32.2%	0.31%	0.02%
Netherlands	88.0%	0.39%	2.2%	47.4%	24.6%	72.0%	0.4%	0.0%	87.8%	0.39%	0.00%
Switzerland	41.0%	0.28%	2.0%	36.4%	37.3%	73.7%	0.32%	0.0%	40.1%	0.28%	0.00%
Norway	30.0%	0.34%	2.2%	56.3%	13.5%	69.8%	0.5%	0.1%	20.8%	0.34%	-0.01%
Finland	69.0%	0.37%	2.1%	44.4%	31.6%	76.0%	0.4%	0.0%	57.3%	0.36%	-0.01%
Denmark	43.0%	0.32%	2.1%	50.5%	18.5%	69.0%	0.4%	0.1%	23.7%	0.31%	-0.01%
Italy	62.0%	0.37%	2.2%	44.5%	36.9%	81.4%	0.4%	0.0%	56.5%	0.35%	-0.02%
Mauritius	33.0%	0.15%	1.7%	43.6%	27.9%	71.5%	0.3%	0.2%	20.7%	0.11%	-0.04%
New Zealand	50.0%	0.29%	1.7%	42.4%	7.3%	49.7%	0.3%	0.0%	23.0%	0.23%	-0.06%
Portugal	69.0%	0.34%	2.0%	41.2%	38.4%	79.6%	0.36%	0.0%	58.3%	0.28%	-0.06%
Average	**42.3%**	**0.3%**	**2.2%**	**55.3%**	**19.0%**	**74.4%**	**0.4%**	**0.1%**	**42.4%**	**0.3%**	**0.039%**

Country	Current holdings			Optimal portfolio					Benchmark		
	Foreign Holdings %	Expected returns	Std. Deviation	International Stocks	International Bonds	Foreign Holdings %	Expected returns	Gains (returns)	Foreign Holdings %	Expected returns	Gains (returns)
Brazil	4.0%	-0.12%	5.8%	100.0%	0.0%	100.0%	0.6%	0.7%	17.8%	0.10%	0.22%
Jamaica	9.0%	0.01%	3.1%	97.9%	2.1%	100.0%	0.6%	0.6%	24.4%	0.16%	0.15%

Thailand	1.0%	0.18%	3.7%	100.0%	0.0%	100.0%	0.63%	0.4%	18.9%	0.34%	0.15%
Indonesia	0.0%	0.07%	4.6%	100.0%	0.0%	100.0%	0.6%	0.6%	16.8%	0.21%	0.14%
Turkey	1.0%	-0.09%	6.1%	100.0%	0.0%	100.0%	0.63%	0.7%	12.8%	0.05%	0.13%
Hungary	1.0%	0.11%	4.0%	100.0%	0.0%	100.0%	0.6%	0.5%	14.6%	0.24%	0.13%
Kenya	3.0%	0.19%	3.9%	100.0%	0.0%	100.0%	0.6%	0.5%	14.6%	0.32%	0.13%
Poland	1.0%	0.11%	3.2%	100.0%	0.0%	100.0%	0.63%	0.5%	17.0%	0.24%	0.12%
Pakistan	0.0%	0.11%	3.9%	100.0%	0.0%	100.0%	0.65%	0.5%	16.5%	0.22%	0.11%
Serbia	0.0%	0.21%	4.0%	100.0%	0.0%	100.0%	0.65%	0.4%	18.4%	0.31%	0.11%
Ukraine	0.0%	0.13%	6.2%	100.0%	0.0%	100.0%	0.64%	0.5%	12.3%	0.23%	0.10%
Costa Rica	13.0%	0.08%	2.1%	58.8%	0.0%	58.8%	0.4%	0.3%	21.8%	0.18%	0.10%
Croatia	13.0%	0.22%	2.7%	83.8%	4.8%	88.6%	0.6%	0.4%	23.4%	0.31%	0.09%
Zambia	7.0%	0.03%	3.6%	37.0%	8.7%	45.8%	0.28%	0.2%	17.7%	0.11%	0.08%
Mexico	13.0%	0.23%	2.8%	79.4%	1.2%	80.6%	0.6%	0.4%	19.1%	0.30%	0.07%
Czech Republic	16.0%	0.24%	3.0%	89.4%	2.2%	91.6%	0.6%	0.4%	19.2%	0.29%	0.05%
South Africa	22.0%	0.21%	2.4%	40.5%	19.4%	59.9%	0.35%	0.1%	27.8%	0.25%	0.03%
North Macedonia	28.0%	0.23%	3.3%	100.0%	0.0%	100.0%	0.6%	0.4%	21.6%	0.26%	0.03%
Nigeria	12.0%	0.09%	4.3%	56.6%	20.7%	77.3%	0.5%	0.4%	12.9%	0.12%	0.03%
Romania	23.0%	0.24%	3.5%	100.0%	0.0%	100.0%	0.64%	0.4%	18.4%	0.27%	0.03%
Estonia	86.0%	0.37%	2.1%	53.4%	18.1%	71.5%	0.4%	0.0%	61.7%	0.39%	0.02%
Slovak Republic	75.0%	0.31%	1.9%	43.0%	23.0%	66.0%	0.32%	0.0%	58.8%	0.32%	0.01%
Slovenia	61.0%	0.32%	2.0%	39.0%	34.5%	73.5%	0.35%	0.0%	58.6%	0.32%	0.00%
Peru	44.0%	0.26%	2.2%	72.3%	19.6%	91.9%	0.47%	0.2%	21.8%	0.26%	-0.01%
Latvia	81.0%	0.34%	1.9%	41.9%	33.7%	75.6%	0.4%	0.0%	58.9%	0.30%	-0.04%
Chile	45.0%	0.24%	1.6%	27.0%	23.2%	50.2%	0.3%	0.0%	31.1%	0.19%	-0.05%
Lithuania	79.0%	0.36%	2.0%	41.4%	35.3%	76.6%	0.4%	0.0%	59.1%	0.30%	-0.05%
Colombia	34.0%	0.18%	1.6%	32.7%	17.0%	49.8%	0.3%	0.1%	21.5%	0.12%	-0.05%
Bulgaria	58.0%	0.31%	2.0%	57.0%	18.8%	75.8%	0.4%	0.1%	20.9%	0.19%	-0.12%
Average	**25.2%**	**0.2%**	**3.2%**	**74.2%**	**9.7%**	**83.9%**	**0.5%**	**0.3%**	**26.1%**	**0.2%**	**0.088%**

5.5 Measuring portfolio gains over time

The analysis in the previous section is useful to identify in the cross-section, countries where pension funds would benefit the most from increasing their current exposure to foreign assets. We also use the methodology to study the evolution of foreign holdings over time and the gains or losses from changes in international securities in the pension funds' portfolios. In other words, in addition to examining the most recent snapshot based of pension holdings, we also evaluate how different pension funds have improved or worsened their investment profile over time. The methodology follows the one described in subsection 5.2, but instead of using information from the most recent portfolio of pension funds, we calculate past returns up to the measurement period, covariances, and systematic risk relative to the world market.[13] To be precise, for a country$c$, we calculate the optimal unconstrained portfolio using the variance-covariance matrix and CAPM model (equation 2) from asset returns from the first data point $t_{0,c}$ to the observation month(requiring at least 60 months with continuous data). The benchmark share of foreign assets $\hat{\gamma}_{c,T}$ is estimated based on the country observables for each corresponding month, and it is then used to calculate the constrained optimal portfolio.

To illustrate how we use of our model in the time series, we present complete yearly findings for three selected countries: Mexico, Romania, and Slovenia. In Figure 7-Panel A, we compare the actual level of foreign holdings relative to the "natural" level from 2007 to 2018. In Panel B, we estimate the gains in excess returns for the unconstrained and constrained portfolio relative to the actual portfolio in each year.

[13] We perform our analysis for country-time pairs with at least 60 months of prior return data.

In Mexico, starting in 2010, pension fund management companies (AFORES for their Spanish acronym) were authorized to invest up to 20% of their assets under management in foreign securities. Interestingly, while these institutional investors quickly raised their foreign exposure following the relaxation of the foreign limit –international holdings grew from 7% to 13% between 2010 and 2013 – further increases in foreign exposure stopped after 2013. Overall, AFORES do not seem to have taken fully advantage of the benefits from additional exposure to foreign assets. In fact, the constraint model suggests that had AFORES continued to increase their share in foreign assets following 2013, to a level of up to 19% (the benchmark level), pension portfolios would have received an additional 1.00% of yearly forward-looking excess returns. Note that such returns are not realized returns, but instead, these are expected returns calculated at the end of each year.

One potential explanation for the slowdown in the rate that funds added foreign assets, might be related to regulatory constraints. Before 2018, AFORES were not allowed to invest in international mutual funds. Notably, as we documented in section 4, this is the preferred investment instrument to access foreign securities among pension fund management companies in the region. Lack of access to international mutual funds might limit an AFORES' ability to enhance, due to the added costs of direct holdings in international markets. A key remaining question is whether the most recent investment regulation, which among other conditions, authorized multiple international holdings in mutual funds starting in 2019 would yield better outcomes in the following years. We should continue our country surveillance to assess the gains from new asset classes, and to examine whether such exposure is at a pace that is closing the gap from the current level of underexposure.

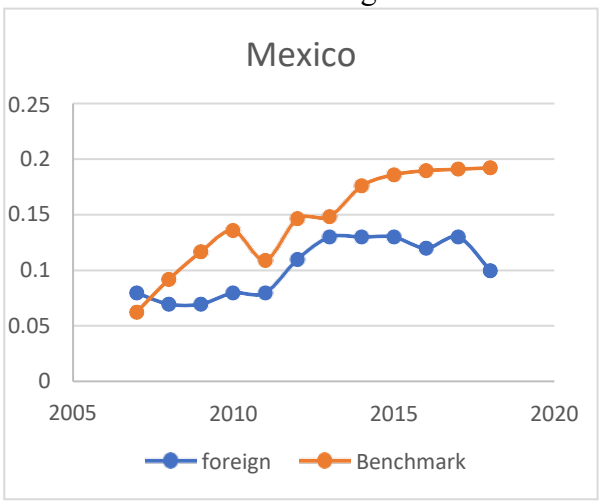
In addition to Mexico, we use our model to estimate the time profile of foreign holdings and gains/losses from diversification in Romania. As the mandatory funded pillar has grown in

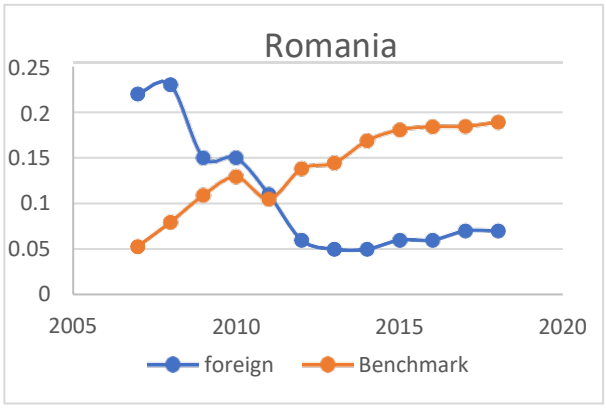
size since its introduction in 2008, pension portfolios have largely concentrated in domestic assets, and in particular, in government bonds. One possible reason may be the relative return guarantee requirements in the system based on fund averages that encourage conservative and broadly similar investment behavior. This level of concentration has come at the opportunity cost from investing in well-diversified international portfolios, rendering lower than expected risk-adjusted returns during 10 consecutive years. The case in Romania is also interesting for another reason; domestic debt, measured from the point of view a local investor, is the riskiest among the countries in our sample (Figure 7-Panel B). More precisely, Romanian fixed-income securities, which are mostly government bonds, have the highest beta relative to the world portfolio in our sample. In turn, domestic pension funds have high systemic risk, to the extent that the unconstrained optimal portfolio is a fully international portfolio, with no domestic securities. While such portfolio allocation is likely unfeasible, both from practical and political reasons, it underscores the nature of the losses in terms of risk and return from maintaining single digit share of assets under management in foreign securities. The low returns come at the backdrop of an already small level of contributions, which was reduced from 5.1% to 3.75% starting in 2018.

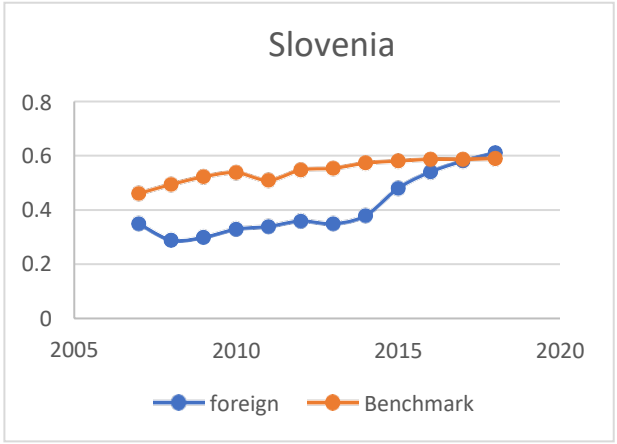
Finally, we present the case of Slovenia. Similar to other common currency countries, the benchmark level of foreign holdings is high throughout the sample period, between 45 and 59 percent. Nonetheless, after 2013, pension funds have significantly increased the share in foreign assets. Such gains narrowed the difference between the optimal and the actual level of portfolio returns. According to the Central Bank, most foreign holdings are equity ETFs and mutual funds focused in developed markets, particularly in the euro area.

Figure 7. Time series of foreign holdings. Actual

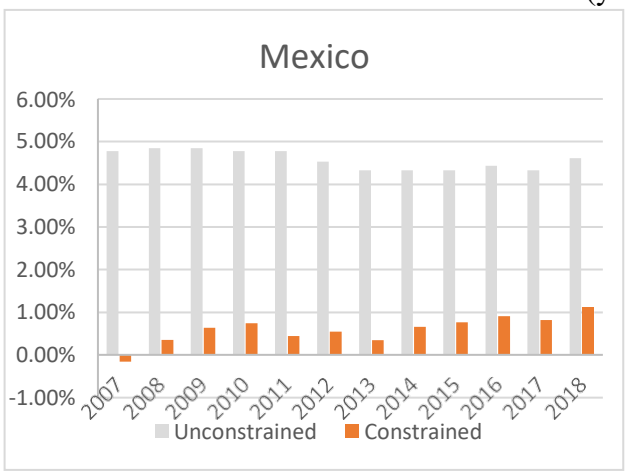
Panel A. Actual holding vs. benchmark

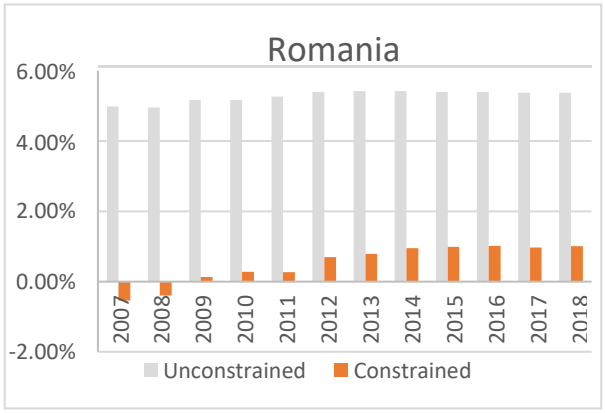


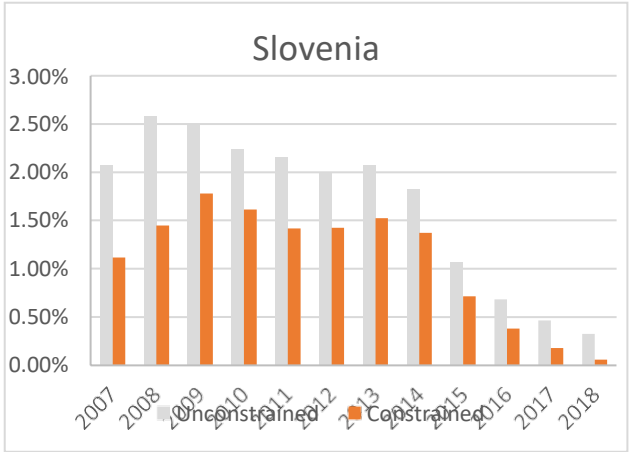




Panel B. Gains from diversification (yearly)







5.6 Limitations

Our approach examines only the asset side, whereas pension funds need to model assets in relation to their future liabilities and the risk characteristics of those liabilities (Blake, 2000). Compared to our approach of using only assets, the asset-liability approach considers asset allocation with respect to the time horizons and risks of the liabilities which will be funded. We do not use this approach, because it requires a full actuarial model for future pension obligations, and because the pension systems in many developing countries are still young with mostly long-term liabilities. In this case, the differences between the two approaches should be minimal. Indeed, it is for pension systems with short-run funding needs where the two approaches may produce material differences.[14]

Second, the benchmark rate that we introduce is not a normative level of foreign holdings. This measure is an estimate to prove a reference based on peers' experience. In other words, it might still be optimal to further increase the exposure to foreign assets beyond the benchmark rate with potential gains to pension portfolios. For our setting, the estimated level of foreign exposure isuseful as it provides and feasible level or anchor to which current policy could be compared.

6. Conclusions

For a policy maker, Table 3 provides a straightforward illustration of the magnitude of opportunity for their country from liberalizing international pension investment rules in relationship to others.

[14] As a related point, lifecycle funds, which represent current best approach for incorporating liability aspects into investment design for defined contribution plans, benefit significantly from being able to incorporate international investments. Typically using only domestic equity assets is difficult.

We recognize that there are many other considerations that policy makers must evaluate when deciding on possible liberalization of such rules, such as a desire to maximize funding of domestic growth. While we discuss other likely causes of resistance to international diversification, given the magnitude of the rapid demographic aging dynamics that are causing unprecedented strain on scheme finances, it becomes increasingly difficult to ignore the levels of opportunity illustrated by our analysis.

In terms of practical advice for policy makers looking to take action on international diversification, we would suggest the following broad principles. First, any change envisioned should be implemented gradually, ideally in a way that is triggered automatically perhaps based upon size of pension assets relative to size of the economy or based upon a combination of more than one of the major variables discussed above. Secondly, progress should be tracked, perhaps against the opportunity as portrayed in Table 3, with a goal of closing any opportunity gaps vs. the wider benchmarks. Finally, implementation should be encouraged in a manner suitable to the capabilities of the funds investing overseas. Specifically, as is apparent from the LAC examples in Appendix B and the Slovenia case, countries that have higher levels of international pension fund investing are often achieving this via international mutual funds, and in many cases indexed funds. This type of lower cost instrument is likely most suitable to pension funds new to international investing and should be encouraged.

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APPENDIX A.

Table A.1 Summary statistics by country

Country	Year on Sample		Previous mayor pension reform	Foreign Holdings			GDP GROWTH	LOGGDP CONSTANT	FDINET INFLOWS	CURRENT ACCOUNTB	CURRENCY DUMMY	MARKET CAP	STOCKS TRADED	LIMIT	PASPGDP	CONTRI-BUTION
	First	Last	Year	Min	Max	Mean	Mean	Mean	Mean	Mean	Value	Mean	Mean	Mean	Mean	Mean
Albania	2011	2018		0,0%	0,0%	0,0%	2,3%	23,3	8,5%	-9,6%	0			30,0%	0,1%	0,0%
Armenia	2014	2018	2018	11,4%	30,4%	24,8%	3,6%	23,2	2,6%	-3,9%	0			40,0%	1,3%	0,5%
Brazil	2011	2018		0,1%	0,4%	0,2%	0,3%	28,5	3,6%	-2,5%	0	39,8%	28,9%	8,8%	12,1%	0,4%
Bulgaria	2001	2018	2002	0,0%	58,2%	28,8%	3,6%	24,6	9,2%	-5,7%	0	16,6%	2,6%	100,0%	5,8%	1,0%
Canada	2000	2018		20,5%	37,1%	29,2%	2,0%	28,1	3,0%	-1,0%	0	116,2%	79,2%	95,0%	64,1%	2,5%
Chile	2002	2018	1981	15,9%	45,1%	35,8%	3,9%	26,1	7,1%	-0,4%	0	105,7%	15,4%	67,9%	61,2%	3,6%
Colombia	2001	2018	1994	4,5%	34,5%	16,5%	4,0%	26,3	3,8%	-2,7%	0	47,4%	5,4%	36,7%	15,3%	1,7%
Costa Rica	2007	2018	2000	1,5%	12,7%	5,6%	3,9%	24,4	6,1%	-4,4%	0	5,3%	0,1%	50,0%	11,8%	1,3%
Croatia	2014	2018	2002	9,2%	13,3%	11,7%	2,2%	24,8	3,6%	3,5%	0	38,1%	0,8%	100,0%	24,8%	1,7%
Czech Republic	2001	2018		4,4%	16,1%	12,5%	2,0%	26,0	4,5%	-2,0%	0	16,0%	9,3%	100,0%	6,0%	0,8%
Denmark	2001	2013		25,5%	42,7%	33,4%	0,9%	26,5	0,9%	4,2%	0	52,7%	26,4%	91,1%	36,1%	0,6%
Estonia	2001	2018	2002	28,2%	85,9%	74,4%	2,5%	23,7	6,8%	-2,5%	1		5,2%	100,0%	7,7%	1,2%
Finland	2002	2008		1,9%	69,3%	43,2%	2,7%	26,2	5,6%	4,9%	1	97,5%	94,1%	100,0%	58,5%	9,6%
Germany	2000	2008		5,7%	46,1%	25,2%	1,4%	28,8	1,8%	3,8%	1	45,1%	63,4%	44,0%	4,0%	0,2%
Guyana	2015	2018		21,1%	30,6%	24,2%					0				6,8%	0,3%
Hong Kong, China	2001	2018	2000	0,0%	80,2%	53,1%					0				30,4%	3,1%

Hungary	2002	2009	1998	0,0%	0,7%	0,4%	-0,4%	25,6	16,9%	-4,7%	0	18,0%	16,0%	100,0%	8,9%	1,4%
Iceland	2008	2018		23,2%	29,1%	25,1%	1,8%	23,4	0,3%	-2,3%	0			100,0%	134,8%	6,8%
Indonesia	2017	2018		0,0%	0,0%	0,0%	5,1%	27,7	2,0%	-1,6%	0	51,3%	9,1%	100,0%	1,8%	0,2%
Israel	2001	2018		0,0%	19,9%	9,0%	3,3%	26,1	3,6%	2,4%	0	72,6%	26,5%	95,0%	40,8%	2,0%
Italy	2014	2018		46,9%	62,1%	52,7%	1,0%	28,4	0,8%	2,1%	1			100,0%	7,2%	0,6%
Jamaica	2012	2018		5,2%	9,5%	7,7%	0,6%	23,3	5,0%	-5,5%	0		2,1%	20,0%	24,8%	
Kenya	2008	2009		2,3%	3,5%	2,9%	1,8%	24,3	0,3%	-5,0%	0	29,9%	1,3%		10,8%	1,1%
Korea	2002	2009		0,0%	0,8%	0,2%					0			100,0%	2,2%	0,4%
Kosovo	2012	2016	2002	71,2%	98,0%	88,6%	3,1%	22,6	4,3%	-6,5%	1			100,0%	18,9%	4,4%
Latvia	2009	2018	2001	53,6%	81,0%	66,1%	0,7%	24,0	2,8%	-0,1%	1			100,0%	1,2%	0,2%
Lesotho	2011	2011		80,0%	80,0%	80,0%					0				10,7%	
Lithuania	2010	2018	2004	68,5%	78,8%	73,1%	3,4%	24,5	2,1%	-0,7%	1			100,0%	5,4%	0,6%
Luxembourg	2005	2010		10,0%	30,3%	19,7%	2,7%	24,7	28,2%	8,7%	1	194,1%	1,0%	100,0%	1,4%	0,4%
Malawi	2016	2018		0,0%	0,0%	0,0%	3,2%	22,9	5,2%	-16,5%	0			100,0%	11,8%	1,5%
Maldives	2011	2013		0,0%	0,0%	0,0%	6,1%	21,8	11,4%	-8,0%	0				3,6%	1,5%
Malta	2011	2011		0,0%	0,0%	0,0%	1,3%	22,9	82,1%	-0,1%	1	36,1%	0,5%	100,0%	0,5%	0,5%
Mauritius	2015	2018		16,0%	32,5%	25,9%	3,7%	23,2	2,8%	-4,1%	0	65,8%	3,3%	70,0%	3,7%	0,5%
Mexico	2001	2018	1997	0,0%	13,3%	8,7%	1,7%	27,7	2,8%	-1,7%	0	33,1%	9,1%	18,3%	12,1%	0,9%
Namibia	2010	2016		25,0%	61,4%	37,9%	4,9%	23,3	5,0%	-8,2%	0	13,3%	0,3%	65,0%	77,2%	3,2%
Netherlands	2000	2018		0,0%	88,0%	57,4%	1,3%	27,5	29,3%	7,5%	1	87,4%	85,5%	100,0%	133,6%	4,3%
New Zealand	2001	2018		0,0%	50,1%	21,9%	3,7%	25,7	1,0%	-3,1%	0	39,6%	6,3%	100,0%	18,2%	1,5%
Nigeria	2008	2011	2005	1,8%	11,7%	4,6%	7,0%	26,6	2,3%	4,9%	0	12,2%	2,2%	0,0%	3,4%	0,9%

North Macedonia	2007	2018	2006	1,5%	28,2%	17,3%	2,8%	23,0	4,1%	-3,8%	0			50,0%	5,1%	0,8%
Norway	2001	2018		0,0%	29,7%	18,1%	1,5%	26,8	2,0%	11,8%	0	52,6%	36,1%	100,0%	7,6%	0,5%
Pakistan	2008	2014		0,0%	0,0%	0,0%	2,7%	25,9	1,4%	-3,0%	0	19,9%	9,3%		0,0%	0,0%
Papua New Guinea	2013	2013		12,8%	12,8%	12,8%	3,8%	23,5	0,1%	-16,2%	0				18,0%	1,9%
Peru	2001	2018	1993	4,8%	43,8%	23,4%	5,1%	25,6	4,1%	-1,8%	0	40,9%	2,5%	40,9%	16,7%	1,3%
Poland	2000	2013	1999	0,0%	1,4%	0,4%	3,5%	26,7	3,3%	-3,4%	0	26,5%	8,7%	29,0%	8,0%	1,2%
Portugal	2000	2018		40,3%	68,6%	52,9%	0,5%	26,2	4,0%	-6,0%	1	34,7%	22,5%	94,3%	10,6%	1,0%
Romania	2007	2018	2008	0,0%	22,9%	8,9%	3,1%	25,9	2,9%	-4,8%	0	9,7%	1,0%	100,0%	2,3%	0,5%
Russia	2005	2005	2003	0,0%	0,0%	0,0%					0				1,5%	0,2%
Serbia	2007	2018		0,0%	0,5%	0,1%	1,4%	24,5	6,1%	-7,4%	0	21,9%	1,8%	10,0%	0,5%	0,1%
Slovak Republic	2001	2018	2005	7,8%	74,9%	48,4%	3,5%	25,2	3,9%	-2,7%	1	4,6%	0,9%	95,0%	6,9%	1,6%
Slovenia	2004	2018		7,6%	60,6%	37,0%	1,7%	24,6	1,9%	0,6%	1	20,8%	1,7%	100,0%	4,5%	0,5%
South Africa	2003	2016		0,0%	21,7%	10,7%	2,8%	26,6	1,4%	-3,7%	0	233,8%	66,4%	21,8%	50,3%	3,5%
Sweden	2005	2006	1999	0,0%	0,0%	0,0%					0				8,6%	
Switzerland	2000	2018		4,2%	41,0%	25,1%	1,8%	27,1	5,6%	10,1%	0	212,2%	127,7%	55,0%	107,8%	7,5%
Thailand	2009	2018		0,1%	0,8%	0,5%	3,2%	26,6	2,2%	5,2%	0	90,8%	67,6%	100,0%	6,1%	0,8%
Trinidad & Tobago	2006	2012		8,5%	23,1%	12,8%	2,6%	23,8	-0,4%	19,0%	0			20,0%	19,1%	0,4%
Turkey	2004	2012		0,0%	0,6%	0,3%	5,7%	27,3	1,7%	-4,4%	0	32,7%	43,1%	100,0%	1,6%	0,3%
Ukraine	2010	2011		0,0%	0,0%	0,0%	4,6%	25,7	4,6%	-4,2%	0	22,2%	1,4%	20,0%	0,1%	0,0%

United Kingdom	2001	2016	2012	24,4%	29,6%	27,0%	1,8%	28,5	4,3%	-3,4%	0	115,4%	87,1%	100,0%	78,4%	2,4%
Uruguay	2016	2016	1996	10,0%	10,0%	10,0%	1,7%	24,6	-0,9%	0,6%	0				23,1%	1,9%
Zambia	2014	2014		6,9%	6,9%	6,9%	4,7%	24,0	5,6%	-1,4%	0			30,0%	3,4%	0,4%

Table A.2. Summary statistics for realized excess returns in sample countries

Country	Index	First date	Excess Returns (%)		Monthly devaluation (%)	beta
			Average	Std. Dev.		
Brazil	BOVESPA Index	Jan-00	0.03	6.93	0.47	-0.01
Bulgaria	SOFIX Index	Oct-00	0.92	8.16	-0.07	1.25
Canada	TSX - Toronto	Jan-00	0.19	3.86	-0.01	0.75
Chile	S&P IPSA	Jan-00	0.39	4.50	0.22	0.63
Colombia	COLCAP Index	Jan-08	0.08	4.58	0.45	0.19
Costa Rica	IACR Index	Jan-00	0.23	5.70	0.12	0.28
Croatia	CROBEX Index	Jan-00	0.45	6.31	-0.03	1.24
Czech Republic	PX Prague SE Index	Jan-00	0.39	5.97	-0.14	1.40
Denmark	OMX Cop 20 Index	Jan-00	0.63	5.17	-0.01	0.95
Estonia	OMX Tallinn Index	Jan-00	1.03	6.88	-0.02	1.46
Finland	OMX Helsinki 25 Index	Jan-00	0.14	5.69	-0.02	1.11
Germany	DAX 30 Index	Jan-00	0.32	5.88	-0.02	1.21
Hong Kong SAR, China	Hang Seng Index	Jan-00	0.38	5.93	0.00	1.07
Hungary	Budapest SE Index	Jan-00	0.44	6.32	0.13	0.96
Iceland	OMX Iceland All Share Index	Jan-00	0.38	7.28	0.29	0.28
Indonesia	Jakarta SE Composite Index	Jan-00	0.47	6.05	0.31	0.47
Israel	Tel Aviv 35 Index	Jan-00	0.41	5.23	-0.04	0.73
Italy	FTSE Italia All Sahre Index	Dec-02	0.09	5.44	0.01	1.07
Jamaica	JSE Market Index	Feb-10	1.24	5.01	0.34	-0.03
Kenya	Nairobi Stock Exchange All Share index	Jan-08	-0.14	5.68	0.27	1.09
Korea, Rep.	Korea SE Kospi Index	Jan-00	0.29	6.17	0.06	0.82
Latvia	OMX Riga Index	Jan-00	0.99	6.37	-0.02	0.84
Lithuania	OMX Vilnius Index	Jan-00	0.89	6.52	-0.02	1.20
Luxembourg	Luxembourg SE LuxX Index	Jan-00	0.03	6.27	-0.02	1.14
Malta	MSE Share Index	Jan-00	0.00	4.03	-0.02	0.24
Mauritius	Semdex Index	Jan-00	0.48	3.97	0.17	0.49
Mexico	S&P/Bmc IPC Index	Jan-00	0.67	5.19	0.33	1.36
Netherlands	Amsterdam Exchange Index	Jan-00	0.00	5.31	-0.02	1.11
New Zealand	S&P/NZX 50 Index	Dec-00	0.55	3.36	-0.10	0.89
Nigeria	Nigerian Stock Ex All Share Index	Jan-00	0.34	6.92	0.53	0.42
North Macedonia	Macedonian SE 10 Index	Dec-04	0.94	9.49	0.13	1.08
Norway	Oslo SE Equity Index	Jan-00	0.64	5.87	0.08	0.95
Pakistan	KSE 100 Index	Jan-00	1.23	7.43	0.47	0.64
Peru	S&P Lima General Index	Jan-00	1.10	7.82	-0.01	1.65
Poland	Waraw SE WIG Pol Index	Jan-00	0.61	5.85	0.03	0.98
Portugal	Euronext Lisbon PSI 20 Index	Jan-00	-0.35	5.30	-0.02	0.75
Romania	Bucharest SE BET Index	Jan-00	1.48	8.08	0.40	0.96
Russian Federation	MOEX Russia Index	Jan-00	1.20	7.90	0.39	1.36
Serbia	Belex 15 Belgrade Index	Oct-05	-0.68	8.13	0.30	1.14
Slovak Republic	SAX Index	Jan-00	0.63	5.21	-0.02	0.36
Slovenia	Ljubljana SE SBI TOP Index	Apr-06	-0.04	5.19	0.12	1.17
South Africa	FTSE/JSE SA ALL Share Index	Jan-00	0.26	4.69	0.46	1.07
Sweden	OMX Stockholm 30 Index	Jan-00	0.20	5.42	0.08	1.09
Switzerland	Swiss Market Index	Jan-00	0.16	3.81	-0.18	0.68
Thailand	SET Index	Jan-00	0.51	6.25	-0.07	1.30
Turkey	BIST 100 Index	Jan-00	-0.09	10.21	1.12	0.34
Ukraine	PFTS Index	Jan-00	0.79	10.91	0.74	0.85
United Kingdom	FTSE 100 Index	Jan-00	-0.06	3.83	0.12	0.82
Zambia	Lusaka All Share Index	Jan-00	0.57	5.31	0.83	0.02

Table A.3. Restrictions on foreign investments (2019)

Countries	Asset classes	Limit[1]	Data
India	All	0%	Central and State Government Pension, National Pension System- Government, National Pension System-Swavalamban: 0% (World). Pension funds cannot invest abroad. It is prohibited by PFRDA Act 2013. National Pension System- Private: 0% (World). Pension funds cannot invest abroad. It is prohibited by PFRDA Act 2013.
Nigeria	All	0%	Defined Contribution Pension Scheme: 0% (World) Defined Benefit Pension Scheme: 0% (World)
Russia	All	0%-30% depending on the pillar and plan	Mandatory funded pillar, default option: 20% of total portfolio. Securities of international financial organisations. Mandatory funded pillar, conservative option (introduced in 2009): 0% (World) Mandatory funded pillar, life annuities portfolio: 20% of total portfolio. Securities of international financial organisations. Mandatory funded pillar, term annuities portfolio: 20% of total portfolio. Securities of international financial organisations. Mandatory funded pillar, Investment portfolios chosen by participants: 20% (World). Securities of international financial organisations. Mandatory funded pillar, Non-state pension funds: 20% (World). Voluntary pension plan: 30% (World).
Brazil	All	10%-40% depending on the Fund Class	Closed pension funds: Up to 10% (World). Open Pension Fund (Defined Contribution Plans) to Qualified Participants: 40% (World). Limits do not apply to the emission´s Place of Issue but to the existence of currency risk. Open Pension Fund (Defined Contribution Plans) to all other Participants: 20% (World). Limits do not apply to the emission´s Place of Issue but to the existence of currency risk. Traditional Plans: 10% (World). Limits do not apply to the emission´s Place of Issue but to the existence of currency risk.
Kenya	All	15%-90% depending on the asset	15%. This limit refers to bank deposits, government securities, quoted equities and rated Corporate Bonds or collective investment schemes reflecting these assets.
Jamaica	All	20%	20% (Canada, the United States of America, the United Kingdom or any other country declared as a recognised jurisdiction by the Financial Services Commission) or the limit prescribed under the Bank of Jamaica Act whichever is lower.
Mexico	All	20%	All Afores, (Siefore) All Funds: 20% (Eligible countries) Other / Comments: Commodities are not considered foreign assets nor do FX positions.
Trinidad and Tobago	All	20%	20% (World). 90% of investments held in member countries of CARICOM is considered as foreign assets, while the remaining 10% of investments in CARICOM countries is considered as local assets.
Ukraine	All	20%	20% (World)
South Africa	All	25%	25% (Listed instruments - listed on an exchange that is a full member of the World Federation of Exchanges) Other/Comments:Maximum of 25% of the total fair value of the assets of a fund. An additional allocation of 5% of the total fair value of assets can be invested in African countries

Zambia	All	30%	30% (World). Not more than 30% of its fund size outside the Republic as may be authorised by the Minister under the Act.
Poland	All	30%-100% depending on the Plan	Open pension funds (OFE): 30% Employee pension funds (PPE): 30% (EU, EEA, OECD Countries) Employee Capital Plans (PPK): No specific limit. Investments restricted to the assets denominated in currencies of EU and OECD countries. 30% in the non-Polish currencies
Colombia	All	40%-70% depending on the Fund Class	Conservative Fund: 40% (World). There is no specific limit for each type of investment issued overseas. Nevertheless, these investments must be rated investment grade. Moderate Fund: 60% (World). There is no specific limit for each type of investment issued overseas. Nevertheless, these investments must be rated investment grade. High Risk Fund: 70% (World). There is no specific limit for each type of investment issued overseas. Nevertheless, these investments must be rated investment grade. Programmed Retirement Fund: 40% (World). There is no specific limit for each type of investment issued overseas. Nevertheless, these investments must be rated investment grade.
Costa Rica	All	50%	Mandatory complementary pension funds (ROP), Voluntary Private Pensions System, Special Occupational complementary pensions funds (DB: Lotery, FRE, ICE and DC: BCAC Ind, BCAC Col, ICT, BCR and Hybrid: BNCR): 50% (World)
Czech Republic	All	50%-100% depending on the Fund Class	Transformed pension schemes (3rd pillar): At least 50% of the assets have to be invested in the currency of the fund´s liabilities. Participation funds: conservative schemes (3rd pillar): No specific limit. Currency risk has to be hedged. Participation funds: other schemes (3rd pillar): No specific limit
North Macedonia	All	50%	Mandatory open pension fund: No more than 50% of the value of the assets of the mandatory pension fund may be invested in instruments issued by a foreign issuer outside the Republic of North Macedonia. Allowed countries abroad are members of the EU or OECD. Voluntary open pension fund: No more than 50% of the value of the assets of the voluntary pension fund may be invested in instruments issued by a foreign issuer outside the Republic of North Macedonia. Allowed countries abroad are members of the EU or OECD.
Hong Kong (China)	All	70%	At least 30% of a fund must be held in Hong Kong dollar currency investments, e.g. currency forward contracts to buy Hong Kong dollars.
Korea	All	70%-100% depending on the Plan	Personal pension insurance: No specific limit (World) Personal pension trust: No specific limit (World) Defined benefit (DB) Retirement pension plans, Defined benefit (DB) Retirement insurance / Retirement trust: Up to 70% (World) Defined contribution (DC) Retirement pension plans, Defined contribution (DC) Retirement insurance / Retirement trust: Up to 70% (World)
Chile	All	80%	All AFPs, Fund A: 100% (World). All AFPs, Fund B: 90% (World). All AFPs, Fund C: 75% (World). All AFPs, Fund D: 45% (World). All AFPs, Fund E: 35% (World). Other/Comments: The joint limit for all funds is 80%.
Albania	All	100%	No specific limit (EU Member States or OECD countries)

Armenia	All	100%	Mandatory pension fund - balanced funds: No specific limit (World) Mandatory pension fund - conservative funds: No specific limit (World) Mandatory pension fund - fixed income funds: No specific limit (World) Voluntary pension fund: No specific limit (World)
Australia	All	100%	No specific limit (World)
Austria	All	100%	No limit, but prudent person rule.
Belgium	All	100%	IORP: No specific limit (World) Insurance undertakings (all life products): No specific limit (World)
Bulgaria	All	100%	Supplementary mandatory universal pension funds (UPF), Supplementary mandatory professional pension funds (PPF): - Generally no specific limit in EU countries, in non-EU countries specified in an ordinance of the national competent authority. - Limit in the rest of the world = 0%, except bills and bonds issued by public administration. - Generally the foreign investments are not treated differently than the domestic. Supplementary voluntary pension funds with occupational schemes (VPFOS): - Generally no specific limit in EU countries, in non-EU countries specified in an ordinance of the national competent authority. - Limit in the rest of the world = 0%, except bills and bonds issued by public administration. - Generally the foreign investments are not treated differently than the domestic. Supplementary voluntary pension funds (VPF): - Generally no specific limit in EU countries, in non-EU countries specified in an ordinance of the national competent authority. - Limit in the rest of the world = 0%, except bills and bonds issued by public administration. - Generally the foreign investments are not treated differently than the domestic.
Canada	All	100%	No specific limit (World)
Denmark	All	100%	Pension savings in ATP, LD, pension funds, life insurance and banks: No specific limit
Estonia	All	100%	Mandatory funded pension: No specific limit (World) Voluntary funded pension: No specific limit (World)
Finland	All	100%	Voluntary plans: company pension funds and industry-wide pension funds: - No specific limit in OECD/EEA countries; - Limit for countries outside the OECD/EEA = 10%. Earnings-related statutory pension provisions for private sector workers, seamen and self-employed persons: No specific limit in OECD/EEA countries.
Germany	All	100%	Pensionskassen: No specific limit (World). There is no specific limit on foreign investments. However, where certain legal risks can arise, foreign investments must be kept at a prudent level. Pensionsfonds: No specific limit (World). There is no specific limit on foreign investments. However, where certain legal risks can arise, foreign investments must be kept at a prudent level.
Gibraltar	All	100%	No specific limit (World)
Greece	All	100%	No specific limit (World). There is no specific limit on foreign investments.
Hungary	All	100%	Voluntary privately managed pension funds (magánnyugdíjpénztár): The ratio of securities issued by non-OECD and non-EEA countries shall not exceed 20% of the foreign investments. Voluntary private pension funds (önkéntes

			nyugdíjpénztar): The ratio of securities issued by non-OECD and non-EEA countries shall not exceed 20% of the foreign investments.
Iceland	All	100%	Investment only permitted in OECD, EU and Faroe Islands securities. But foreign currency exposure should not exceed 50% of accrued liabilities. Limit for investments outside the OECD, EU and Faroe Islands = 0%.
Ireland	All	100%	Occupational pension plans, Trust retirement annuity contracts: No specific limit (World) Personal Retirement Savings Accounts (PRSAs): Direct investment not allowed.
Israel	All	100%	- Limit on securities issued by a country rated at least BBB- = 100%; - Limit on securities issued by OECD residents = 100%; - Limit on securities issued countries which are rated below BBB- and which are not part of the OECD = 0%.
Italy	All	100%	No specific limit (World)
Japan	All	100%	Employees' Pension Fund (EPF), corporate DB pension funds, corporate DC pension funds, individual DC funds, national pension funds: No specific limit (World). Mutual aid associations (MAAs): No specific limit (World).
Luxembourg	All	100%	Pension savings companies with variable capital (SEPCAVs), Pension savings associations (ASSEPs): No specific limit (World) Defined benefit CAA supervised pension funds: No specific limit (World)
Malta	All	100%	Personal Retirement Schemes: No specific limit
Netherlands	All	100%	No specific limit (World)
New Zealand	All	100%	No specific limit (World)
Norway	All	100%	No specific limit
Portugal	All	100%	Closed pension funds, Open pension funds: No specific limit (OECD / EU regulated markets) - Limit for investments not traded in an EU and OECD regulated market = 15%. Personal retirement saving schemes (PPR) financed through pension funds: No specific limit (OECD / EU regulated markets) - Limit for investments not traded in an EU and OECD regulated market = 10%.
Romania	All	100%	Private pension fund - second pillar: No specific limit (World). No specific limits on investments in foreign assets. The limits are established for each asset class. Private pension fund - third pillar: No specific limit (World). No specific limits on investments in foreign assets. The limits are established for each asset class.
Slovak Republic	All	100%	Privately managed mandatory pension system - Bonds Guaranteed Fund: No specific limit (OECD / EU regulated markets/ European Economic Area) Privately managed mandatory pension system - Equity Non-Guaranteed Fund: No specific limit (OECD / EU regulated markets/ European Economic Area) Privately managed mandatory pension system - Other types of funds: No specific limit (OECD / EU regulated markets/ European Economic Area) Voluntary personal pension plans - contributory pension funds: No specific limit (OECD / EU regulated markets/ European Economic Area) Voluntary personal pension plans - pay-out pension funds: No specific limit (OECD / EU regulated markets/ European Economic Area)

Slovenia	All	100%	No specific limit, unless specifically disclosed
Spain	All	100%	No specific limit (OECD). Limit for assets not admitted to be traded on a regulated market. Only investments in OECD countries is permitted. In this case, offshore investing is forbidden by the Law.
Sweden	All	100%	Friendly societies: No specific limit (World) Life insurance undertakings: No specific limit (World) Providers of occupational retirement pensions: No specific limit (World)
Switzerland	All	100%	No specific limit (World)
Thailand	All	100%	100% but subject to the following conditions: - Securities must be regulated by regulator that is an IOSCO member, including Cambodia, Lao PDR and Myanmar; - Listed instruments must be listed on an exchange that is a full member of the World Federation of Exchanges.
Turkey	All	100%	No specific limit (World)
United Kingdom	All	100%	No specific limit (World)
United States	All	100%	No specific limit; no additional limitations are applicable. (World)
Maldives	All	NA	No specific limit. Maldives Retirement Pension Scheme has not yet started investing in any foreign assets, hence no limit has yet been set for foreign investments.
Pakistan	All	NA	Private pension funds under VPS - equity sub-fund: No specific limit (World) Private pension funds under the Voluntary Pension System (VPS) - debt sub-fund: No specific limit (World) Private pension funds under the Voluntary Pension System (VPS) - money market sub-fund: No specific limit (World) Private pension funds under the Voluntary Pension System (VPS) - commodity sub-fund: No specific limit (World) Other/Comments: Regulations are silent on foreign investments (neither prohibit nor allow), however no pension fund manager has approached SECP for investment in foreign assets. If a request is received, SECP will consider it on merit.
Tanzania	All	NA	According to the social security schemes investment guidelines 2015, Off-shore investment by the schemes shall be in accordance with, and governed by the Foreign Exchange Act and Regulations, Directives and Rules issued by the Bank from time to time, in this case offshore investments have only been allowed for east Africa region.

1 Limit refers to the percentage of funds that is allowed to invest overseas

Source *Annual Survey of Investment Regulations of Pension Funds and Other Pension Providers (OECD)*

APPENDIX B.

B.1 International securities

In Section 4, we analyze the main drivers of foreign holdings. An outstanding question is the type of securities that managers use to access international markets. Table 1 provides some suggestive evidence. For instance, pensions funds with a higher share of fixed income investments tend to invest more domestically. It is possible that these funds have a higher concentration in domestic government securities and thus allocate only a small portion of their portfolios internationally. According to Table 1, funds with the lowest exposure to foreign assets (in quartile 1) invest up to 40% of their assets in treasury bills and in bonds. Conversely, it appears that funds that allocate a larger portion of their investments through investment companies, and in particular, via mutual funds, invest more internationally. The evidence however is only suggestive since OECD does not collect detailed portfolio information.

To examine the international investment strategies of pension funds, we use detailed security-level data collected from local supervisory authorities for a sample of Latin American countries – Chile, Colombia, Mexico, and Peru.[15] We differentiate between direct holdings of securities among these investors, and delegated assets into other investment funds. For example, pension fund investments into fund of funds, mutual funds, or in Exchange Traded Funds (ETFs). Finally, to examine the level of active management among these investors, we examine portfolio allocations to passive strategies –investment in equity and fixed-income funds that passively track a benchmark index.

[15] Complete portfolio data is available for Colombian funds between 2008 and 2018. For Chile, the data covers the years 2013-2018 and for Peru, 2014 to 2018.

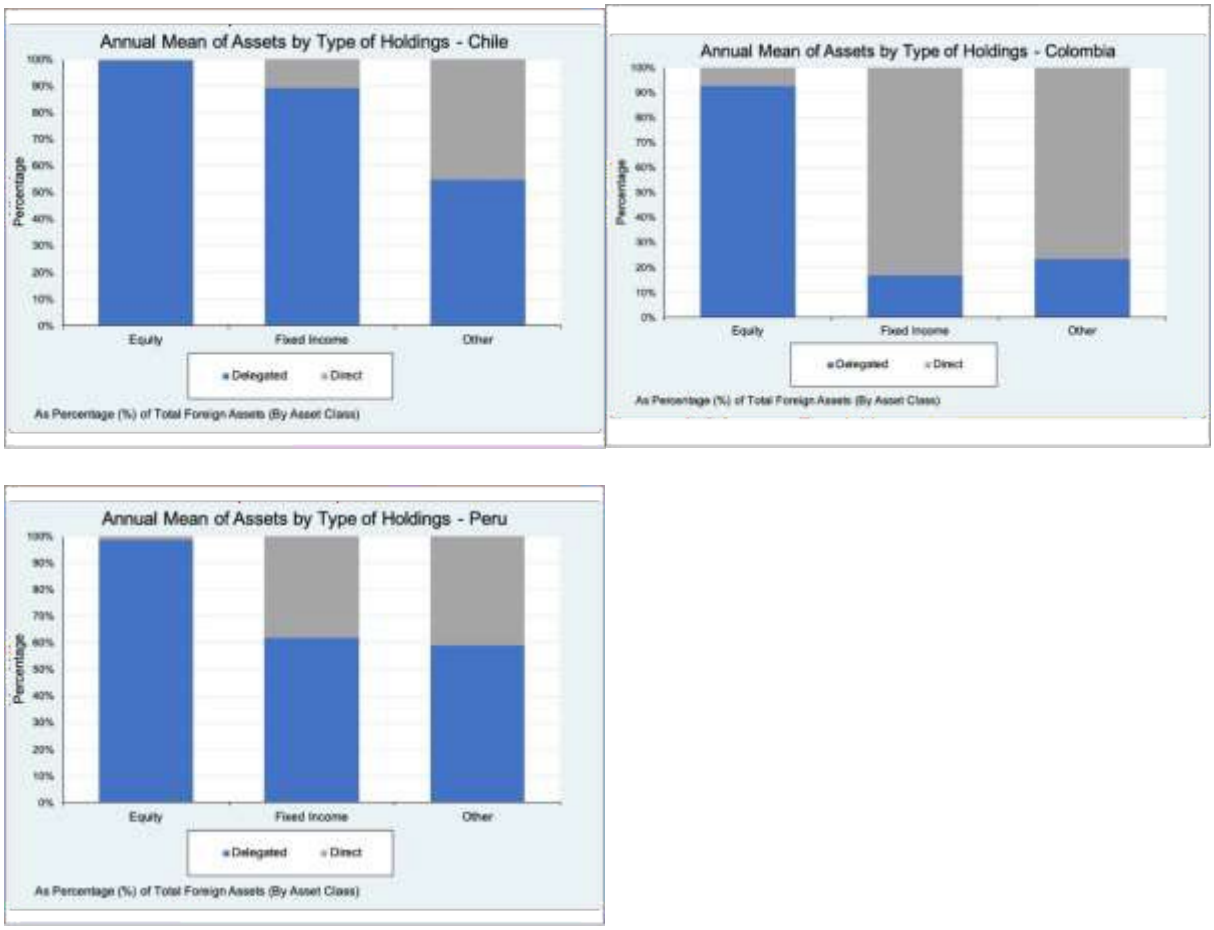
The share of foreign investments by pension funds vary across these three countries and over time. Despite general differences in aggregate holdings, pension funds in the region appear to use similar strategies to gain exposure to foreign assets (Figure B.1). To be precise, most international holdings are concentrated in equity securities and are accessed via delegated investments. For example, in 2017, 93% of all foreign holdings by pension funds in Peru were through investment funds, and the remainder 7% were direct security holdings. Moreover, in this same year, 84% of all foreign holdings were equity investments. A similar pattern is found in Chile and Colombia. Figure B.3 also disaggregates foreign holdings by asset class and type of investment for each country. The figure further confirms the evidence that most international investments by pension funds, especially for equity securities, are through indirect holdings. The documented ratio between delegated and direct holdings is particularly interesting because it is a broad contrast with the domestic allocation of pension funds. In Colombia and Chile, for example, domestic equity investments are exclusively in direct holdings of local stocks, 99% and 97% respectively.

Figure B.1. % of foreign equity investments

Figure B.2. Delegated foreign investments

Source: Local supervisory pension agencies. Authors' calculations.

Figure B.3. Type of foreign security by county



Source: Local supervisory pension agencies. Authors' calculations.

Pension funds not only are less likely to hold international securities directly, but their foreign strategy is typically more passive. For instance, the majority of foreign investments by pensions funds are in passively managed funds, either self-declared index funds or ETFs. For example, by the end of 2018, 82% of the investments in international fixed-income securities by Colombian pension funds were made via index funds. The other 18% was allocated to fixed-income funds with active management strategies. It is possible that passive strategies in global investments are optimal if institutional investors are less well-informed about their target countries.

In this case, uninformed managers seeking to invest in global markets might self-select into explicit index funds perhaps attracted by their low fees.

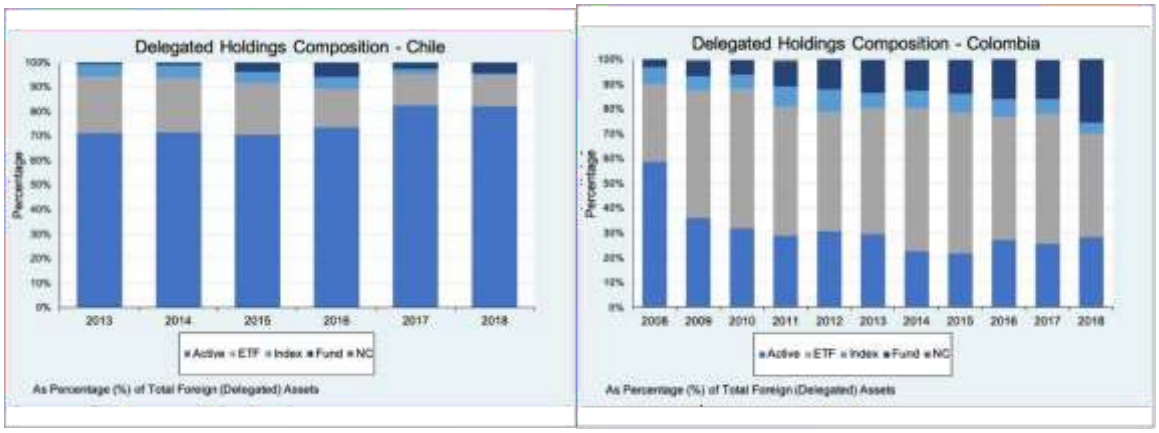
The process of financial globalization fostered by capital account liberalizations, electronic trading, increasing exchanges of information across borders, and falling transaction costs has certainly led to a large increase in cross-border asset trade. For pension funds, lenient regulation with recent increases in the limits of foreign holdings allows more international exposure.[16] At least for pension funds in Chile, Colombia, and Peru, foreign exposure has provided an opportunity for global diversification. In Figure B.4, we report the international focus of the mutual funds and ETFs that pension funds are using to access foreign assets. The figure reports as a percent of delegated assets, the focus of each fund. For example, a pension fund that invests in an international mutual fund with exclusive focus to developed countries would be classified under this group.[17] Importantly, there is large variation in the focus of the funds that pension management companies are using. During the last five years, pension funds in Peru have increased their exposure to developing countries.

In summary, international holdings of pension funds in Chile, Colombia, and Peru, are more passive, are often performed via investment funds, and have been expanding their international focus to multiple markets in recent years.

[16] It is of interest to note that such regulations are not always "binding," meaning that in some cases the level of international assets held is well below the allowable limit, as mentioned in this paper regarding cases in Mexico and Colombia.

[17] The classification is based on the objective of the fund. For example, a LATAM fund differs from an emerging markets fund in that the LATAM fund would exclusively focus on securities in Latin America.

Figure B.4. International focus of pension fund investments



Source: Local supervisory pension agencies. Authors' calculations.

B.2. Box: Colombia's experience with International Diversification

The experience in Colombia has shown that international investments can have multiple positive effects for the portfolio of mandatory pension funds. Recent data (2019) indicates that Colombian pension funds have 33% of their portfolio in overseas investments. In a few different

ways, these investments have been an important stabilizing force for the pension fund portfolios; perhaps most notably in 2020 as a key source of liquidity during moments of market stress.

Administradoras de Fondos de Pensiones (AFPs) in Colombia began to significantly incorporate international investments after 2005 as domestic yields started a steady decline. Additionally, the relative size of the AFPs vis-à-vis the domestic market began to be more of a concern as well given increased trading costs and reduced liquidity for the investment lot sizes needed by the pension funds. Currently, regulation in Colombia allows AFPs to invest up to 40% of their portfolio overseas – this has not been a binding limit historically but the trend over time has continued to increase. The advent of the multifund system helped contribute to this increase and the recent rule change (decree 959) of 2018 to the multifund system that will result in younger participants defaulting to the high-risk fund (with relatively higher international investment) will further amplify this trend.

In moving toward more foreign investments, there has been a learning curve for the AFPs. They have had to navigate the process of negotiating fees and structure concerns with global investment management firms. They have made this process easier for themselves by focusing largely on overseas developed market equity, and by most typically using passive fund structures based upon highly liquid and well-known indices. These instruments provide strong diversification benefits while still being available at a competitive cost level. The financial supervisory regulator in Colombia (Superfinanciera de Colombia – SFC) has encouraged the moveto largely developed market equities via regulatory requirements that allow foreign investments only in countries with strong credit ratings, good equity listing requirements and regulations that either meet or exceed those in Colombia.

Recent experience during the COVID-19 market gyrations of early 2020 have shown the importance of maintaining a significant portion of their portfolio in overseas investments. As marketsseized up in March, in some cases the international holdings provided the only reasonable sourceof liquidity on short notice. Additionally, despite the dramatic volatility, non-Colombian equity investments performed relatively better in 2020 on a Colombian peso (COP) basis; although the MSCI All Country World Index (ACWI) declined about 1% in the first half of the year in USD terms, in Colombian peso terms it was up by about 10%. Meanwhile the MSCI Colombia index was down by roughly 30% in the same period in local currency terms. Given this reality, it is clear that AFP portfolios with relatively higher investments overseas performed relatively better than those with only domestic equity investments.