European University Institute

DEPARTMENT OF ECONOMICS

Three essays in Macroeconomics and Finance

Damien Puy

Thesis submitted for assessment with a view to obtaining the degree of Doctor of Economics of the European University Institute

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Examining Board

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Abstract

This thesis addresses three issues in the fields of macroeconomics and international finance.

The first chapter examines how institutional investors, such as mutual funds and hedge funds, tend to transmit economic and financial shocks across borders. Using a novel micro-level dataset on portfolio investments from a vast number of funds located in advanced markets, I find strong evidence of contagion propagating through the fund industry. Changes in economic and financial conditions in advanced markets generate global waves of portfolio inflows (outflows) with a massive impact on emerging markets' funding. I illustrate this finding by deriving contagion maps showing where contagion spreads and with what intensity. I also find that countries that are politically unstable and that are remote from the main financial centers are the main victims of such contagion. Overall, the results clearly suggest that push effects from advanced market investors affect developing countries and expose them to sudden stops and surges.

The second chapter, co-authored with Shekhar Aiyar, Romain Duval, Longmei Zhang and Yiqun Wu, investigates the existence, and potential determinants, of the so-called "middle income trap", defined as the phenomenon of rapidly growing economies stagnating at middle-income levels and failing to graduate into the ranks of high income countries. We examine the middle-income trap as a special case of growth slowdowns and identify slowdowns as large sudden and sustained deviations from the growth path predicted by a basic conditional convergence framework. We then examine their determinants by means of probit regressions, looking into the role of institutions, demography, infrastructure, the macroeconomic environment, output structure and trade structure. Two variants of Bayesian Model Averaging are used as robustness checks. The results—including some that speak to the special status of middle-income countries—are then used to derive policy implications.

The third chapter, co-authored with David Pothier, proposes a theory explaining the cyclical properties of the income distribution. We develop a two sector general equilibrium model in which agents have non-homothetic preferences and differ in terms of their initial ownership of capital. We show that when sectors differ in terms of their relative labour- and capital-intensity, changes in the composition of aggregate demand is an important channel through which productivity shocks are propagated through the economy. We then use this framework to study the distributional consequences of business-cycle shocks. Consistent with empirical evidence, we find income inequality (as measured by the Gini coefficient) to be counter-cyclical and this effect to be driven mostly by changes in the level of employment and, to a lesser degree, by changes in relative factor prices. Interestingly, we also find that changes in the concentration of capital ownership have negligible effects on both the level and the cyclical properties of income inequality.

"*Genuineness only thrives in the dark. Like celery.*" A. H.

Acknowledgments

This section is dedicated to the long list of people that helped me go through these Ph.D years.

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To finish, I am dedicating this Ph.D to my wife, who made all this possible and much more.

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<u>Chapter III: Demand Recomposition and the Distribution of Income</u>

Chapter 1 - Institutional Investors Flows and the Geography of Contagion*

Damien PUY

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Abstract

This paper explores the geography of portfolio investments emanating from institutional investors based in mature markets using a novel dataset of high frequency portfolio flows. We identify precise global and regional dynamics in equity and bond flows. Very few countries receive (or lose) funding in isolation. We also find strong evidence of global contagion: although global waves originate in developed markets, emerging markets' funding is much more affected. We illustrate this finding by deriving contagion maps showing where contagion spreads and with what intensity. In general, our results suggest that push effects from advanced market investors affect massively developing countries and expose them to sudden stops and surges. [JEL F32, F36, G11, G15, G23]

1 Introduction

Do institutional investors propagate shocks? and if yes, to whom? Over the last decade, a growing literature has documented the ability of financial intermediaries to propagate shocks across borders, even in the absence of common fundamentals. Along with banks, the fund industry has attracted particular attention and is now recognized as an important vehicle of financial contagion[1]. To date, a number of empirical contributions have found compelling evidence of "contagious" portfolio

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[1]For a discussion, see Gelos (2011).

rebalancing at the fund level, with adverse consequences for countries within the same portfolio.[2] Yet, little is known about the geography of contagion. Where does contagion actually spread? So far, the existing literature has little to say about this issue. Recent research based on fund level data is usually restricted to a small set of investors, which makes it uneasy to derive general conclusions about contagion patterns.[3] In addition, most studies tend to focus on developing countries during crisis periods, leaving the impression that adverse phenomena, such as sudden stops, surges or spillovers, are restricted to emerging markets in times of high financial stress. However, recent evidence has also pointed to fire sales (or purchases) from funds propagating shocks across mature markets, suggesting that such phenomena are in fact more general.[4] As a result, some important questions remain to be explored: How do "micro" patterns, such as contagious portfolio rebalancing or fire sales/purchases, translate at the macro level? Second, who is affected? Can we identify contagion patterns, or typical "spillovers" areas? Finally, what are the countries that are most sensitive to contagion?

This paper addresses these questions in three steps. As a starting point, we build on Jotikasthira, Lundblad and Ramadorai (2012) and use a novel dataset of weekly portfolio flows emanating from a vast number of equity and bond funds between 2001 and 2011. In contrast with them however, we do not restrict our attention to global funds and use the full dataset (including hedge funds, ETFs and regional funds), thereby increasing significantly the industry and country coverage. As of 2011, the dataset was collecting information from more than 25,000 equity funds and 15,000 bond funds representing $15 trillion of assets invested in over 80 mature and emerging markets. When compared to CPIS data on year-end foreign portfolio investment holdings (equity and debt securities) at the country level, we find that these funds account altogether for, on average, 25% of total foreign portfolio investments. Second, to capture the complex dynamics of fund flows at the global level, we rely on large factor analysis and decompose the panels of bond and equity flows into world, regional and idiosyncratic components using a Bayesian dynamic latent factor model in the spirit of Kose, Otrok and Whiteman (2003). Coupled with an extensive dataset, this parametric decomposition allows us to identify the existence of both global or regional spillovers, as well as to derive a measure of sensitivity to different types spillovers (global or regional) for each country in our sample. Once on a map, such measures also generate an intuitive "contagion map" illustrating where contagion spreads and with what intensity. Finally, we build on these measures and investigate what determines, at the country level, such sensitivity to contagion. Building on different strands of literature, we consider a vast set of variables, ranging from typical macro variables (in-

[2] See in particular Kaminsky, Lyons and Schmukler (2004), Broner, Gelos, and Reinhart (2006), Boyer, Kumagai and Yuan (2006), Coval and Stafford (2007), Jotikasthira, Lundblad and Ramadorai (2012), Raddatz and Schmukler (2012).

[3] Kaminsky, Lyons and Schmukler (2004) study a sample of 13 Latin American funds, whereas Broner, Gelos, and Reinhart (2006) use data from 117 emerging market funds over 4 years.

[4] Hau and Lai (2012) and Manconi, Massa and Yasuda (2012) both highlighted the role of equity and bond funds in propagating the great financial crisis.

stitutions quality, fiscal balance, sound money...) to corporate measures of transparency, and run a horse race between competing variables using two Bayesian averaging algorithms, namely the WALS methodology from Magnus, Powell and Prufer (2010) and the standard BMA popularized by Sala-i-Martin, Doppelhoffer and Miller (2004).

Our main findings are the following. First, although the dataset aggregates flows from a vast number of funds, the model identifies very precise world and regional dynamics in equity and bond flows, with a substantial impact on all countries in our sample, including advanced markets. According to the variance decompositions, only a handful of countries happen to receive/lose funding in isolation. Second, we find strong evidence of both (i) regional contagion in bond flows and (ii) global contagion in both equity and bond flows. In the case of regional contagion, the model highlights the presence of a region grouping "all emerging markets", implying that emerging markets have a tendency to receive (or lose) funding at the same time, irrespective of their actual location or macroeconomic environment. This, in turn, is consistent with emerging market bonds being an asset class *per se,* in which investors herd when in search for yield, or retrench from when conditions deteriorate. In the case of global contagion, we find that, for both equity and bond flows, the global factor is driven by economic news and financial stress conditions in developed countries, with periods of high (low) financial stress and poor (good) macroeconomic outlooks in advanced markets being associated with equity and bond outflows (inflows) at the world level. However, although these global waves originate in developed countries, emerging markets' funding is much more affected than mature markets'. In the case of equity flows, we find that 75% of the variability of emerging markets funding is driven by these push factors originating in the domicile of funds. Using "contagion maps" illustrates this finding nicely: we find that "core" advanced countries are not substantially affected by the global push factors whereas almost all emerging markets at the "periphery" display very high sensitivity levels, both in relative and absolute terms. Third and finally, after investigating formally the determinants of such sensitivity to global contagion, we find that the level of political risk, as well as the distance between the location of the fund and the recipient country, are the best predictor of contagion sensitivity. In other words, when facing a shock at home, investors tend to cut (or increase) their exposure to risky countries to a greater extent. Our results suggest that distance and political risk act as the main "risk criteria" in the eyes of investors and managers, thereby exposing fragile emerging countries to sudden stops (or surges).

Taken together, our results are well connected to three different strands of the literature. First, we contribute to the empirical literature on international mutual funds. To date, most contributions had focused on finding evidence of destabilizing behaviours at the fund level, rather than on identifying how such behaviours might affect countries' external funding.[5] Our results complement

[5]This includes overreaction (Kaminsky, Lyons and Schmukler (2004), Borensztein and Gelos (2003)), momentum

these studies by showing that portfolio rebalancing from funds at the micro-level translate, in aggregate, into massive global and regional co-movement in portfolio investments. Interestingly, we also find that extending the coverage in several dimensions (industry, time, space) does not necessarily invalidate the conclusions of studies based on micro level data. To the contrary, some findings, in particular from Raddatz and Schmukler (2012) and Jotikasthira *et al* (2012), seem to be at play. Using data on global funds, Jotikasthira *et al* (2012) found that funding shocks originating at "home", *i.e* where funds are domiciled, translate into fire sales (and purchases) in countries within the same portfolio, in particular emerging markets. Similarly, Raddatz and Schmukler (2012) found that when country returns change or crises strike, both investors and managers respond by adjusting their investments in the whole portfolio, thereby transmitting shocks across countries. Moreover, their behavior tends to be pro-cyclical, reducing their exposure to all countries during bad times and increasing it when conditions improve. The high procyclicality of fund flows at the world level and the strength of global contagion in developing countries we observe in our sample strongly support such a transmission channel. To our knowledge, we are the first to map and quantify the impact of these portfolio rebalancing at the world level.

Second, the significance of political risk and geographic distance in scaling the sensitivity to global contagion relates to a number of studies coming both from empirical finance and international macroeconomics. Until now, both strands had highlighted different variables to explain capital flows volatility.[6] Although we are unable to compare these studies directly, the horse race between all variables tend to reconcile both strands of literature. Better institutions, in form a stable political environment, as well as lower information asymmetry, as captured by geographic distance, both seem to reduce the sensitivity of countries to sudden stops (or surges) from international investors. On the other hand, the significance of distance against other measures of transparency suggests that *soft* measures of information asymmetry might play a stronger role than *hard* measures of transparency at the level of fund managers.

Third, our results have important implications for the so-called "push-vs-pull" factor debate.[7] Using variance decompositions, we find although (global) push factors initiate global waves of portfolio investments, structural "pull" factors (such as political stability or distance) determine the direction

trading (Grinblatt, Titman, and Wermers (1995), Froot, O'Connell, and Seasholes (2001)), herding (Wermers (1999), Choe, Kho, and Stulz (1999), Kim and Wei (2002), Hsieh *et al.* (2011)), fire sales (Coval and Stafford (2007), Jotikasthira *et al.* (2012)) or "contagious" portfolio rebalancing (Broner *et al.* (2006), Jotikasthira *et al.* (2012), Raddatz and Schmukler (2012)).

[6] Broner and Rigobon (2005) showed that better institutions can help reducing capital flow volatility. Using fund level data, Gelos and Wei (2005) reported that during crises, funds tend to flow more from less transparent countries and that herding is more pronounced in less transparent markets. Ferreira and Matos (2008) also emphasized the importance of corporate transparency, showing that institutional investors reveal a preference for stocks of countries with strong disclosure standards.

[7] For early contributions on this debate see Calvo *et al* (1993, 1996), Chuhan *et al* (1998), Fernandez-Arias (1998), Kim (2000), Griffin, Nardari and Stulz (2004). See Forbes and Warnock (2012) for a thorough review and additional references.

and magnitude of these flows. This finding is well connected to other empirical contributions that have emphasized the importance of mature market conditions - such as interest rates, liquidity, risk levels or weak economic performance - in generating capital movements.[8] Recently, Ghosh *et al.* (2012) also found that when surges in capital flows to EMEs occur, domestic pull factors affect the exact magnitude of the inflow across countries. On the other hand, our findings seriously downplay the relevance of short-term pull factors, such as purely domestic growth/productivity shocks, in driving flows and appear more in line with recent case studies that found "little or no role for domestic macroeconomic conditions".[9]

The remainder of this paper is organized as follows. Section 2 presents the dataset and important stylized facts. Section 3 details the econometric framework and results. Section 4 discusses our key findings. Section 5 concludes.

2 Dataset and Stylized facts

2.1 EPFR Portfolio flows dataset

The portfolio investment dataset used in this paper is provided by the EPFR global, a private company tracking the performance and asset allocation of a vast number of equity and debt funds domiciled in developed countries and important offshore financial centers.[10] Since its creation in 1996, the coverage of the EPFR global has increased significantly, reaching currently a wide industry and geographic coverage. As of 2013, the EPFR global was collecting information from more than 29,000 equity funds and 18,000 fixed-income funds representing US$20 trillion of assets invested in over 80 mature and emerging markets.

To understand further the composition of EPFR funds and its evolution over time, Appendix A provides an in-depth analysis of the EPFR database, distinguishing funds by (i) Type of Asset (Equity, Bond, Balanced, Money Market or Alternative) (ii) Geographic focus (iii) Type of client (Retail *vs* Institutional) (iv) Management Rule (Active *vs* Passive) and (v) Redemption and Valuation rules (Open *vs* Closed-End Funds, ETF *vs* Non-ETF). The most notable findings can be summarized as follows. First, following the rise of the fund industry over the last 15 years, the

[8] Fratzscher (2012) found that during the GFC global shocks (key crisis events, changes to global liquidity and risk measured by the VIX) had a large effect on capital flows during both the crisis and the recovery. Kim (2000) found that capital movements in four developing countries (Mexico, Korea, Chile and Malaysia) was largely due to external reasons such as decreases in the world interest rate and recession in industrial countries. See Forbes and Warnock (2012) for further references on the importance of conditions in large economies in driving capital flows.

[9] See for instance Alper (2000) in the case of Turkey and Mexico, or Kim (2000) for Chile, Mexico, Korea and Malaysia.

[10] As of 2007, 46% of funds in the EPFR sample were domiciled in the US, 27% in Luxembourg, 9% in the UK and 4% in Ireland.

sum of assets under management covered by EPFR increased tremendously, from US$ 1 trillion in early 2003 to more than US$ 22 trillions in 2014. Second, equity funds have always represented the biggest share of the total asset coverage, followed by bond funds and more recently by money market funds. Third, in absolute terms, most of equity and bond funds investments have been made (and are still made) in developped economies, such as North America, Western Europe and developped Asia. However, in relative terms, Emerging Market funds turn out to be more representative of the total external funding received at the country level: using Coordinated Portfolio Investment Statistics (CPIS) data on year-end foreign portfolio investment holdings (equity and debt securities) for 80 countries in 2011, and comparing them with the sum of assets covered by EPFR (aggregating over all funds) in each of these countries, we find that in 2011, EPFR funds accounted for, on average, more than 25% of total foreign portfolio investments at the country level, and that the coverage is higher for equity investments and emerging markets. Fourth, although most EPFR funds are mutual funds with a retail focus and open-end structures, we find that ETFs and institutional funds have been increasingly represented in the EPFR sample over the last 10 years. This trend is also partly reflected in the rise of funds categorized as "passively managed".

We now turn to the data used in this paper. As our purpose is to understand the evolution of international funding at the country level, we follow Fratzscher (2012) and use only one data category - "net country flows" - which is constructed as follows: for each period and for each fund, EPFR collects the amount of cash flowing in and out of the fund, as well as the share allocated to each country within the fund. Once aggregated across funds and sorted by recipient country, the sum of these flows determines the "net country flow", which provides the amount of capital lost (or received) by the country over the reference period from the overall universe of funds tracked by EPFR, net of injections/redemptions, portfolio performance and currency fluctuations. Figures 1 and 2 below report the monthly country flows computed by the EPFR, distinguishing between equity and bond flows. Equity flows are available from 1996 to 2011 whereas bond flows are reported only from 2003 onwards. For simplicity, both types of flows are presented at the regional level. Moreover, net country flows are adjusted by the total level of Asset Under Management (AUM), which reports the stock of assets invested in the recipient country at the beginning of the month. Hence, a drop of 3% in country i at month t implies that country i "lost" 3% of the total funding that was invested at the end of the previous month, in $t-1$. The level of AUM acts as an important scale variable that allows to interpret the magnitude of the inflow/outflow as well as to control for changes in the sample of the funds covered.[11]

[11]Inflows (or outflows) are always reported in dollars, which can be hard to interpret. Once normalized by the size of holdings previously invested in the country, the flow variable (now expressed in % of AUM) indicates whether the country lost most (or only a small portion) of its external funding over a given period. In addition, because EPFR gradually expanded its coverage to include more funds over time. Using the lagged level of assets invested allows us to control for this upward trend in the sample size. Therefore, in the remainder of the article and except

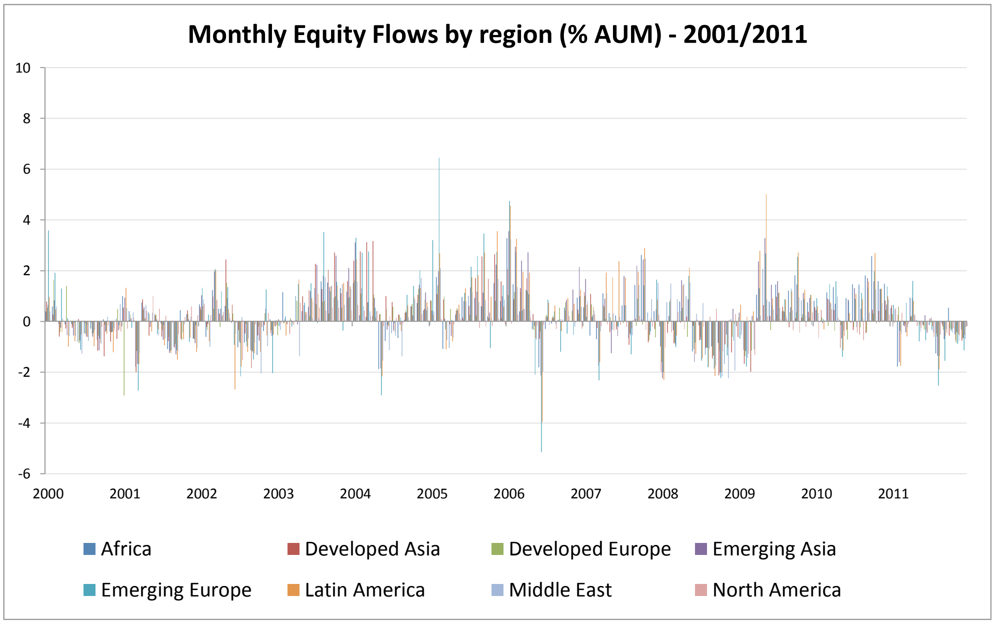

Figure 1: Equity Flows 1996 - 2011

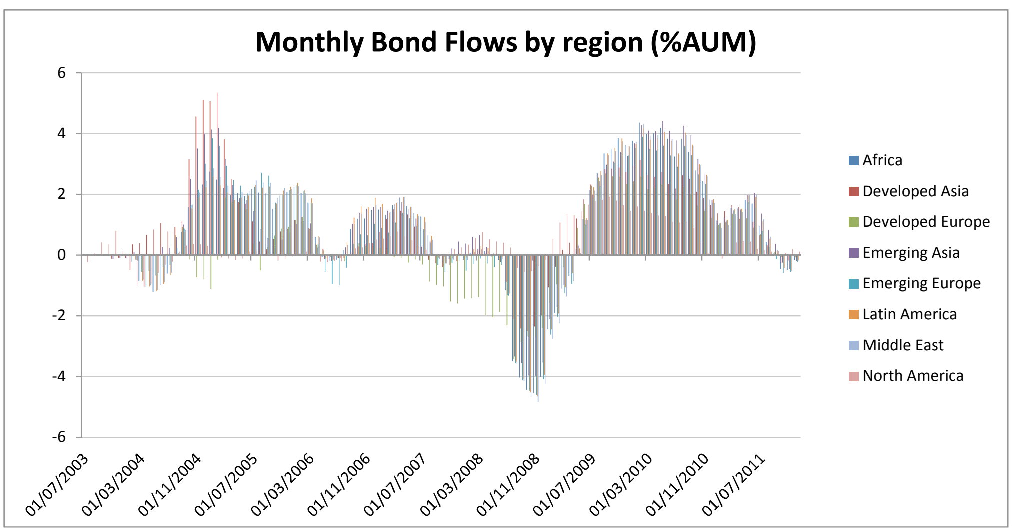

Figure 2: Portfolio Bond Flows 2003 - 2011

Before exploring further the geography of international portfolio flows, we emphasize the key strengths of the EPFR global dataset, in particular compared to other financial flows sources. First, flows are reported at a high frequency, which allows to better monitor investors and managers response to economic shocks.[12] Second, the EPFR global offers a wide industry and geographic coverage which goes a long way in addressing some of the shortcomings of the existing literature. On the one hand, using a vast range of investors offers a better assessment of institutional investors' impact at the global level. To date, evidence of destabilizing behaviour from international investors tended to be restricted to small samples of funds, making it impossible to assess the consequences of these micro-behaviours for international capital flows patterns.[13] On the other hand, the vast country and time coverage permits the identification of co-movement in flows (i) at the world level and (ii) during tranquil periods. To our knowledge, most empirical studies have focused on subsets of the world and/or crisis events, leaving the impression that funds behaviour affect exclusively emerging markets during episodes of high financial stress.[14] An important finding of this paper will be to show that co-movement in flows is a more general phenomenon, which also takes place among advanced markets and in normal times. Third and finally, the EPFR dataset has been found to be a reliable data source. Comparing TNAs (Total Net Assets) and monthly returns of a subsample of EPFR funds to CRSP mutual fund data, Jotikasthira *et al.* (2012) found only minor differences between EPFR and CRSP datasets. In addition, although EPFR only captures a subset of (gross) portfolio inflows, Miao and Pant (2012) showed that EPFR fund flows correlate well with BoP recorded capital flows into emerging markets, thereby suggesting that EPFR flows act as a timely and accurate proxy for overall portfolio inflows to emerging markets.[15] As a result, the EPFR global dataset has been used in recent seminal contributions on shock progagation through funds, in particular in the "country flows" format used in this paper.[16]

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when explicitly specified, inflows and outflows are always adjusted (%AUM).

[12]Traditional BOP data are available only at a quarterly frequency, whereas the Coordinated Portfolio Investment Survey provide only year-end data on portfolio investment holdings. Chan, Covrig and Ng (2005) and Hau and Rey (2008) use data on mutual fund holdings from Thomson Financial securities that are limited to semi-annual observations. Such frequencies are better suited for "stock" analysis, such as home bias, than flow analysis.

[13]Kaminsky, Lyons and Schmukler (2004) study a sample of 13 Latin American funds whereas Broner, Gelos, and Reinhart (2006) use data from 117 emerging market funds over 4 years. Jotikasthira *et al.* (2012) consider a bigger set of funds, but restrict attention only to global funds.

[14]Broner *et al.* (2006) study the behaviour of equity funds only during emerging market crisis. Boyer, Kumagai and Yuan (2006) also find evidence of contagion contrasting the behavior of investable and non-investable indices during crises. Kim and Wei (2002) compare foreign portfolio investements before and during a crisis.

[15]Other important sources of portfolio investments are not captured by EPFR, such as proprietary trading desks of foreign brokers and investment banks, foreign insurance companies investing their excess cash, and wealthy individuals and individual companies purchasing company stocks for strategic reasons or to invest excess cash. On the other hand, emerging markets rely substantially on funds in developped market for external funding. As a result, although EPFR funds represent a small portion of gross portfolio inflows in absolute terms, they might be very representative of the behavior of their investor base as a whole. See Appendix A for an illustration of the strong correlation between equity and bond flows in EPFR and BoP recorded gros inflows to Emerging Markets.

[16]See Raddatz and Schmukler (2012), Jotikasthira *et al* (2012), Fratzscher (2012) and references therein.

2.2 Stylized facts: Cycles and Co-movement in Portfolio flows

Given the dimension of the dataset used in this paper, this section first summarizes the important properties of international portfolio flows emanating from investors between 1996 and 2011. Two features, in particular, are highlighted for both equity and bond flows: (i) the cyclical behaviour of fund flows (ii) the strong degree of co-movement across countries. We provide more formal evidence supporting these two stylized facts and discuss their implications for the geography of international investors flows.

As a first step, we build on Bry and Boschan (1971) and apply the following filter to monthly equity and bond flows at the country level:

- Step 1: Months of inflows/outflows are first identified using a dummy variable which takes the value 1 if the flow is positive and -1 if the flow is negative. Formally, defining $y_{i,t}$ as the flow of asset (% AUM) to country i in month t, we create the indicator variable $D_{i,t}$ defined as:

$$D_{i,t} = 1 \quad if\ y_{i,t} \geq 0$$

$$D_{i,t} = -1 \quad if\ y_{i,t} < 0$$

- Step 2:
  - Periods of sustained inflows or outflows are respectively defined as a "*Surge* phase" or a "*Retrenchment* phase" if they last at least 2 consecutive months;
  - Alternatively, periods over which a month of inflows alternate with a month of outflow qualify as "*Undefined* phase"
- Step 3: Finally, we define $S_{i,t}$ a "phase" variable taking value 1 if country i at time t experienced a *Surge* phase, and 0 if it experienced a *Retrenchment* phase.

Using the variable $S_{i,t}$, we first compute summary statistics about phases characteristics at the regional level in tables 1 and 2. This includes the number of phases, the average duration of phases (in months) and the average gain (or loss) over each phase (in % of AUM). To study the co-movement properties of portfolio flows, we then compute a diffusion index as derived in Harding and Pagan (2002, 2006). Formally, the diffusion index measures the *share of countries,* in our sample, experiencing the same phase each month. For the case of retrenchments, the index is computed as follows:

$$Diff_t = \sum_1^N w_{i,t} F_{i,t}, \quad where \sum_1^N w_{i,t} = 1 \; and \; t = 1, ..., T$$

where $w_{i,t}$ is the weight assigned to *i-th* country at time t, $F_{i,t}$ is a binary variable taking the value 1 if the *i-th* country experiences a retrenchment and 0 otherwise, and N is the cross-sectional dimension. In what follows, we assume an equal weight of $1/N$ for all countries. The diffusion index for Surges is simply one minus the diffusion index for Retrenchments. Figures 3 and 4 report the diffusion index for both equity and bond datasets.

Table 1 highlights some important properties of equity flows between 1996 and 2011. First, the algorithm identifies a strong cyclical pattern, with on average 18 phases identified for developed regions and 25 phases for emerging regions, leaving only around 10% of the sample out of the "phase" identification framework.[17] Second, periods of "retrenchment" are significantly shorter, suggesting that investors leave countries faster than they enter. Third, developed regions tend to have fewer and more protracted phases than emerging markets. Fourth and finally, there is a stark difference in the amplitude of the phases across regions.[18] During surge phases, emerging regions tend to gain more than twice as much funding than developed economies. However, they also tend to lose twice as much during retrenchment phases. Taken together, these findings suggest that emerging regions experience higher "volatility" insofar as they experience more phases of shorter length and of greater amplitude. Looking at table 2, we find that most of the stylized facts highlighted above also characterize bond flows. In particular, we still observe (i) a strong cyclical pattern (ii) a sharp asymmetry in the duration of surge *vs* retrenchment phases, and (iii) a greater amplitude of phases in the case of developing regions. It is important to note however that the bond sample is significantly shorter than the one used for equity flows for some regional aggregates are only available from 2005 onwards.[19] More importantly, most of the sample covers the Global Financial Crisis (henceforth GFC), implying that the stylized facts are not easy to generalize. In fact, the behaviour of bond flows over these years might reflect more the peculiarity of the period than any structural difference in the behaviour of this asset class.

Figures 3 and 4 highlight the other important finding, namely the co-movement of flows at the country level. Note that by construction, a value close to 0 of the diffusion index indicates that countries all tend to experience phases of surges, whereas a value close to 1 suggests that all countries experience a retrenchment phase. Most notably, the index often takes extreme values (close to 1 or 0), implying that most of the sample moves in the same direction, i.e either receiving/losing funding at the same time. This finding is true for both bond and equity flows. Not surprisingly, we also find that most periods of retrenchment are associated with notable financial events. Figures

[17] More precisely, the number of months categorized as undefined accounts for only 10% of the sample for each region. Results available on request.

[18] We refer to "amplitude" loosely to designate the cumulative loss or gain over a phase.

[19] Although some regional flows are reported from 2003 (see Figure 2), all seven regions are in fact reported consistently only from 2005 onwards. Therefore, the stylized facts are computed using only data from 2005.

	Number of Months		Phase Analysis: Number of Phases		Phase Analysis: Duration (in months)			Phase Analysis: Average Cumulative loss/gain (%)	
	Inflows	Outflows	Surge	Retrenchment	Surge	Retrenchment	Assymetry	Surge	Retrenchment
	(1)	(2)	(3)	(4)	(6)	(7)	(8) (6)/(7)	(9)	(10)
Developed	**97.3**	**75.3**	**9.0**	**9.0**	**9.8**	**7.4**	**1.3**	**6.4**	**-5.1**
Asia	104	87	9	9	10.3	8.2	1.26	8.9	-7.9
Europe	120	71	9	8	12.6	7.4	1.70	7.5	-4.5
North-America*	68	68	9	10	6.6	6.5	1.01	2.9	-3.1
Emerging	**117.6**	**73.4**	**14.0**	**11.6**	**8.1**	**5.2**	**1.6**	**15.9**	**-9.8**
Africa	129	62	16	13	7.9	3.9	2.02	14.4	-9.3
Emerging Asia	116	75	14	11	7.6	4.8	1.59	15.1	-9.6
Emerging Europe	116	75	14	10	8.2	5.8	1.42	20.7	-10.5
Latin America	105	86	12	12	8.1	6.8	1.18	16.8	-10.0
Middle East	122	69	14	12	8.6	4.8	1.80	12.4	-9.7

*only 136 months

Table 1: Summary Statistics - Regional Equity Cycles

	Number of Months		Phase Analysis: Number of Phases		Phase Analysis: Duration (in months)			Phase Analysis: Average Cumulative loss/gain (%)	
	Inflows	Outflows	Surge	Retrenchment	Surge	Retrenchment	Assymetry	Surge	Retrenchment
	(1)	(2)	(3)	(4)	(6)	(7)	(8) (6)/(7)	(9)	(10)
Developed	**64.0**	**31.7**	**4.3**	**4.3**	**12.6**	**4.5**	**3.8**	**6.6**	**-5.3**
Asia	71	25	5	5	14.0	4.6	3.0	8.7	-5.1
Europe	51	36	5	5	9.8	7.0	1.4	8.2	-7.8
North-America	70	34	3	3	14.0	2.0	7.0	2.8	-3.1
Emerging	**66.2**	**27.4**	**4.2**	**4**	**15.4**	**5.2**	**3.0**	**8.9**	**-8.1**
Africa	67	26	4	4	16.5	5.5	3.0	8.3	-7.8
Emerging Asia	70	26	5	4	13.2	5.0	2.6	10.4	-6.7
Emerging Europe	59	34	4	4	14.3	6.5	2.2	8.9	-6.8
Latin America	67	26	4	4	16.5	4.5	3.7	8.5	-9.4
Middle East	68	25	4	4	16.5	4.5	3.7	8.5	-9.8

Table 2: Summary Statistics - Regional Bond Cycles

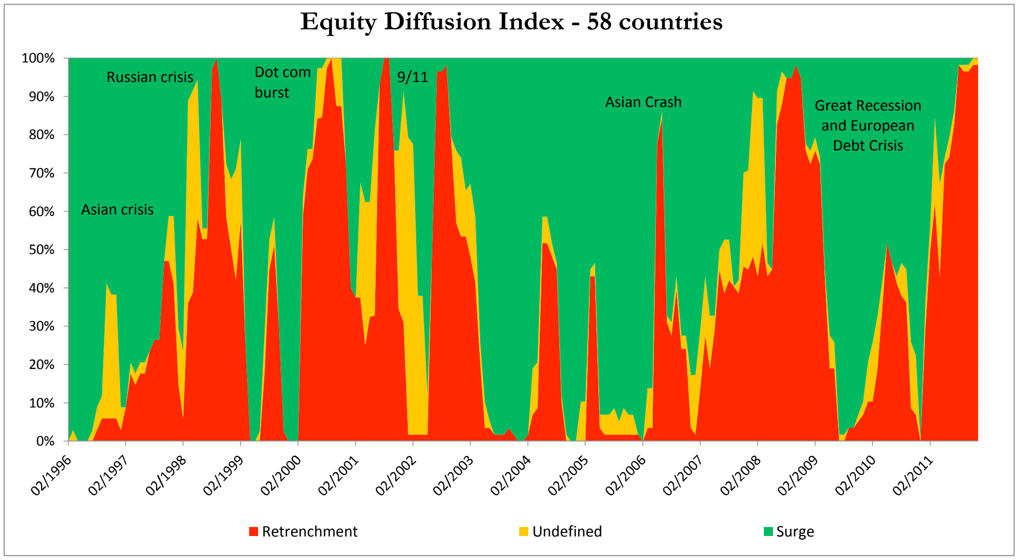


Figure 3: Cross Country Diffusion Index - Equity Flows

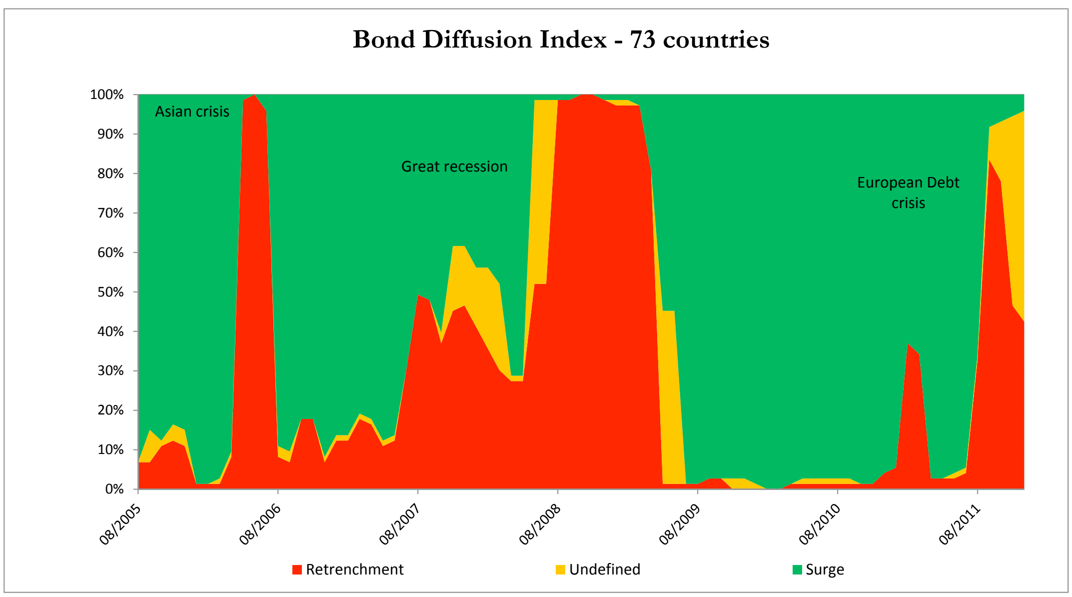


Figure 4: Cross Country Diffusion Index - Bond Flows

3 and 4 allow us to track the consequences of the major financial and economic shocks of the past 15 years on both equity and bond flows.

Taken together, these findings bring new evidence on the behaviour of international portfolio flows emanating from the fund industry. We find that they (i) exhibit a strong cyclical behaviour and (ii) they co-move substantially across countries. Moreover, emerging countries exhibit a high volatility insofar as they experience cycles with more phases, of shorter length and of greater amplitude. At the same time, they raise important questions as to the geography of fund flows. The strong level of synchronization of flows, in particular, suggests the presence of global dynamics affecting some (if not all) countries in our sample. To further explore the dynamics and geography of portfolio investments, we build on large factor analysis and decompose bond and equity flows into world, regional and country-specific components.

3 Econometric Model

In this section, we build on Kose, Otrok and Whiteman (2003) and estimate the following latent factor model:

$$y_{i,t} = \beta_i^w f_t^w + \beta_i^r f_{j,t}^r + \varepsilon_{i,t} \qquad (1)$$

where $y_{i,t}$ is the (demeaned) flow of funds (equity or bond) in country i at time t at a monthly frequency, f_t^w is the (unobserved) world factor affecting all countries in our sample at time t, $f_{j,t}^r$ is the (unobserved) regional factor affecting all countries belonging to region j at time t, and β_i^w and β_i^r designate country-specific factor loadings measuring the responses of country i to the world and regional factors respectively. Finally, $\varepsilon_{i,t}$ is an unobserved country-specific factor. Note also that observations in the vector $y_{i,t}$ are measured as % of total AUM so that they report the loss (or gain) over month t with respect to the level of asset invested in the country in month $t-1$.

Because we allow factors to follow AR processes, the model in (1) is in fact a dynamic latent factor model. More precisely, we assume that the idiosyncratic factors follow an $AR(p)$ process:

$$\varepsilon_{i,t} = \rho_{i,1}\varepsilon_{i,t-1} + ... + \rho_{i,p}\varepsilon_{i,t-p} + u_{i,t} \qquad (2)$$

where $u_{i,t} \sim N(0, \sigma_i^2)$ and $E(u_{i,t}, u_{i,t-s}) = 0$ for $s \neq 0$ and world and regional factors follow the respective $AR(q)$ processes:

$$f_t^w = \rho_1^w f_{t-1}^w + ... + \rho_q^w f_{t-q}^w + u_t^w \qquad (3)$$

$$f^r_{j,t} = \rho^r_{j,1} f^r_{j,t-1} + ... + \rho^r_{j,q} f^r_{j,t-q} + u^r_{j,t} \qquad (4)$$

where $u^w_t \sim N(0, \sigma^2_w)$, $u^r_{j,t} \sim N(0, \sigma^2_{j,r})$, $E(u^w_t, u^w_{t-s}) = E(u^r_{j,t}, u^r_{j,t-s}) = 0$ for $s \neq 0$. Finally, shocks in (2)-(4) are fully orthogonal to each other.

Because factors are unobservable, standard regression methods do not allow the estimation of the model. As a consequence, we rely on Bayesian techniques with data augmentation as in Kose, Otrok and Whiteman (2003) to perform the estimation. As a first step, we normalize the sign of the factor/loadings by (i) restricting the loading on the world factor for the first country in our sample to be positive and (ii) restricting the loadings on the regional factor for one country in each region to be positive. Second, to normalize the scales, we assume that each of the factor variances (σ^2_w and $\sigma^2_{j,r}$) is equal to 1. Note that these normalizations do not affect the qualitative results and simply allow the identification of the model. In addition, we use Bayesian techniques with data augmentation to estimate the parameters and factors in (1)-(4). This implies simulating draws from complete posterior distribution for the model parameters and factors and successively drawing from a series of conditional distributions using a MCMC procedure. Posterior distribution properties for the model parameters and factors are based on 300.000 MCMC replications after 30.000 burn-in replications.

A key ingredient is the choice of the priors in the estimation. Once again we follow Kose, Otrok and Whiteman (2003) and use the following conjugate priors:

$$(\beta^w_i, \beta^r_i)' \sim N(0, I_2) \qquad (5)$$

$$(\rho_{i,1}, ..., \rho_{i,p})' \sim N(0, diag(1, 0.5, ..., 0.5^{p-1})) \qquad (6)$$

$$(\rho^w_1, ..., \rho^w_q)' \sim N(0, diag(1, 0.5, ..., 0.5^{q-1})) \qquad (7)$$

$$(\rho^r_{j,1}, ..., \rho^r_{j,q})' \sim N(0, diag(1, 0.5, ..., 0.5^{q-1})) \qquad (8)$$

$$\sigma^2_i \sim IG(6, 0.001) \qquad (9)$$

with $i = 1, ..., N$ and IG denoting the inverse Gamma distribution, implying a rather diffuse prior on the innovations variance. Finally, we assume that AR processes in (2)-(4) are stationary. In our implementation, we set the length of both the idiosyncratic and factor auto-regressive polynomials to 2. However, other (non-zero) values for p and q were tried with no substantial differences in the results.

Before turning to the results, we mention that beside the estimation of the factors and loadings, we are interested in measuring the influence of the different factors on each country's level of international portfolio funding. Therefore, we will pay particular attention to the variance decompositions for each country in our sample. Given that factors are orthogonal to each other, we can compute θ_i^w:

$$\theta_i^w = (\beta_i^w)^2 var(f_w^t)/var(y_{i,t}) \qquad (10)$$

$$\text{where } var(y_{i,t}) = (\beta_i^w)^2 var(f_w^t) + (\beta_i^r)^2 var(f_{j,t}^r) + var(\varepsilon_{i,t})$$

where θ_i^w reports the proportion of total variability in country's i funding attributable to the world factor. θ_i^r and θ_i^c are defined similarly and measure the share of variance captured by the regional and country-specific factors, respectively. As we shall see, these variance decompositions provide a natural measure of a country's sensitivity to different types of dynamics.

3.1 Data and Regional Decomposition

Following Jotikasthira *et al.* (2012), we address potential data issues by rearranging the "raw" country flows dataset in several standard ways. First, to avoid data errors, misreporting or outliers, country flows are considered only (i) for countries for which flows are consistently reported throughout the sample period (ii) for countries experiencing a change in AUM over one month strictly smaller than 50% in absolute value.[20] Second, funds for which no geographic allocation information is available, *i.e.* for which no sufficient information exists on the countries in which assets are invested, are also excluded. After this standard data cleaning, the equity sample ranges from 2001 until 2011 (121 months) and covers 58 countries for a total of 7018 observations. The bond model ranges only from 2005 until 2011 (77 months) and covers 73 countries, for a total of 5621 observations.

As a benchmark, equity and bond models are estimated using seven regions, namely: (i) North America (ii) Latin America (iii) Developed Europe (iv) Emerging Europe (v) Middle East and Africa (vi) Developed Asia and (vii) Emerging Asia. Countries within each region are detailed in Appendix A. It is important to note however that this regional decomposition is just one out many possible regional decompositions. In particular, one might think of many other potential classifications based on, *inter alia*, trade zones, currency zones, common language or risk profile. In an application of factor models to international business cycles, Kose *et al* (2003) used geographical regions because countries that are physically close to each other are likely to be highly connected

[20]This minimizes the influence of potential outliers. Moreover, it discards countries with extremely low level of portfolio investment.

through trade. In our framework, the case for geographical regions is not as straightforward. On the one hand, investors might still invest in (or exit) regions because they anticipate that geographical regions move together, supposedly because of trade or financial connections. Moreover, the presence of so-called "dedicated funds" that have restricted mandates to invest only in particular regions of the world also supports the use of geographical regions. On the other hand, many global funds or funds with a thematic focus - such as high-yield bond funds or sector-specific funds - are known to enter (or leave) subsets of countries with no clear geographic or economic links. If the latter were to dominate in our sample, then geographical regions could end up being a rather poor proxy of the true regional decomposition. Although evaluating the full set of competing regions is far beyond the scope of this paper, both models are also re-evaluated using two alternative regional groupings, each of them representing an extreme "paradigm": (i) a geographic decomposition and (ii) a development decomposition.[21] The performance of the models under these three regional decompositions are then compared using as a criteria (i) the increase in the share of variance accounted for by the regional factor (ii) the precision of (estimated) regional factors.

3.2 Results

3.2.1 World Factors and Factor Loadings

Estimated world factors for equity and bond flows are plotted respectively in Figures 5 and 6. For simplicity, country-specific world factor loadings for the full sample of countries are reported in Appendix B.

Both Figures 5 and 6 highlight important findings. First, we find that in both models the interval between the dashed lines - which delineate the 0.05 and 0.95 quantiles for the posterior distribution - and the solid line is very narrow, implying that the world factor is estimated precisely and that there is clear common driving force in international portfolio funding. Second, the cyclical behavior of the world factors is apparent in both figures, although the longer time series available for the equity model highlights this feature more clearly. To emphasize this cyclical behavior further, Figures 7 and 8 decompose the world factors in periods of global surges (in green) and global retrenchments (in red). Doing so, we see clearly that periods of global inflows and outflows tend to alternate, although the length of the cycles differs over time. Finally, a look at the factor loadings shows that, for both equity and bond flows: (i) all countries have a positive coefficient and (ii) emerging markets tend to have a higher coefficient. In other words, although all countries move in the same direction after a unit deviation in the world factor (either receiving/losing funding), the

[21] The geographic paradigm assumes 5 regions: (i) North America (ii) Latin America (iii) Europe (v) Africa and Middle East (vi) Asia. The development paradigm assumes only two regions, namely (i) developed countries and (ii) developing/emerging markets.

magnitude of the change is greater for developing or emerging markets. This, in turn, confirms the higher amplitude of both surge and retrenchment phases in emerging regions highlighted in Section 2.

What might cause all investors to invest - or liquidate their positions - at the international level? To gain some insight about what the world factor is capturing, we first plot the world factors against notable economic and financial events in Appendix B. This qualitative analysis reveals that waves tend to be generated by major financial stress events and/or changes in macroeconomic conditions in developed economies. In particular, the US recession of the early 2000, the accounting scandals or the Great Recession coincided with phases of massive global equity outflows. Similarly, interest rate hikes or unexpected changes in the economic outlook in major markets - such as the EU or the US - seem to have provoked global retrenchments in 2004, 2005 and 2006.[22] Conversely, declines in financial stress, low interest rates or good economic news triggered global waves of equity inflows. A very similar picture emerge for bonds flows although bond flows reacted only after Lehman's bankruptcy in September 2008.

To confirm formally the importance of financial and macroeconomic conditions in developed countries in driving the direction of global portfolio flows, we regress the equity and bond world factors on a set of explanatory variables mapping these different dimensions. Tables 3 and 4 report the results of a regression of world factors on (i) the Financial Stress Index computed by the Kansas City Fed (henceforth KCFSI)[23] (ii) the level of short term interest rates in developed economies measured as the unweighted average of Fed funds (in the US) and main ECB refinancing rate (in the Eurozone) and (iii) economic news shock series in the G10 countries measured by the Citi Index of Economic surprises.[24] Given the importance of inflation for bond investors, we also use a global inflation news shock series for the bond factor regression.[25] Both levels and differences of the variables are considered when relevant.

Looking at tables 3 and 4, we find that all regressors help to explain the waves of portfolio flows, although some types of shock seem to matter more in crisis periods than during normal times. For the global equity factor, we find that, using the full sample, increases in financial stress and (unexpected) poor economic outlook in advanced markets are strongly associated with global outflows. Using only the sample before the GFC, the level of financial stress and the level of interest

[22]The US Federal reserve hike by 25 basis point in early 2006 triggered massive equity outflows, in particular from Asian emerging markets. Between May and July 2006, Asia Pacific stock markets experienced their biggest decline since 2002.

[23]The Kansas City Fed is a monthly measure of stress in the US financial system based on 11 financial market variables and captures both liquidity conditions and risk appetite. For a review of the methodology, see Hakkio and Keaton (2009).

[24]The Citigroup Economic Surprises index is defined as a weighted historical standard deviation of data surprises. A positive reading of the index implies that economic releases have on balance been better than the market consensus.

[25]the global inflation news shock is computed as the unweighted average of the G10 and Emerging Markets Citi index of Inflation data surprises.

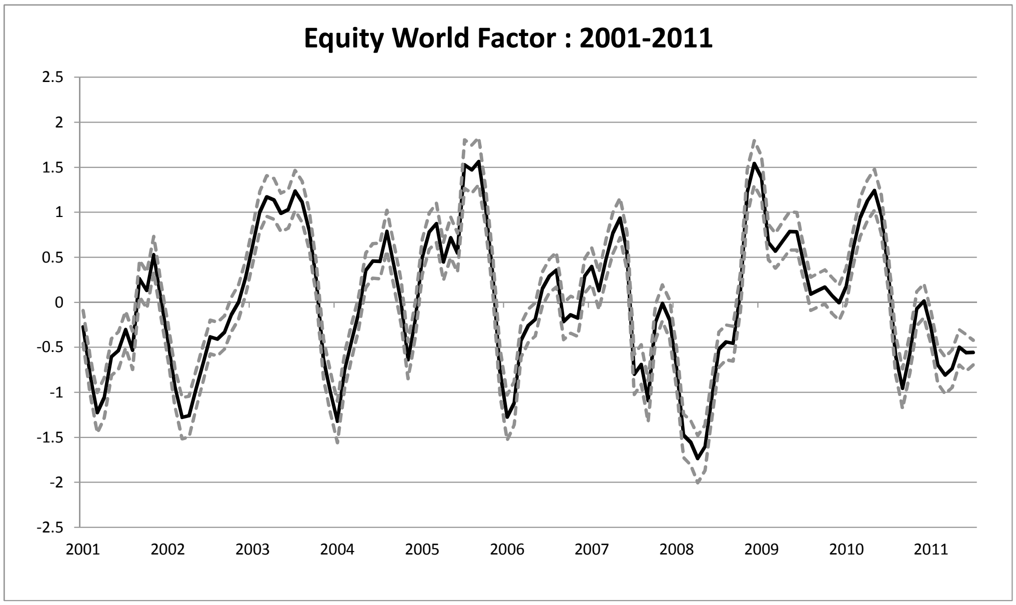


Figure 5: World Factor - Equity

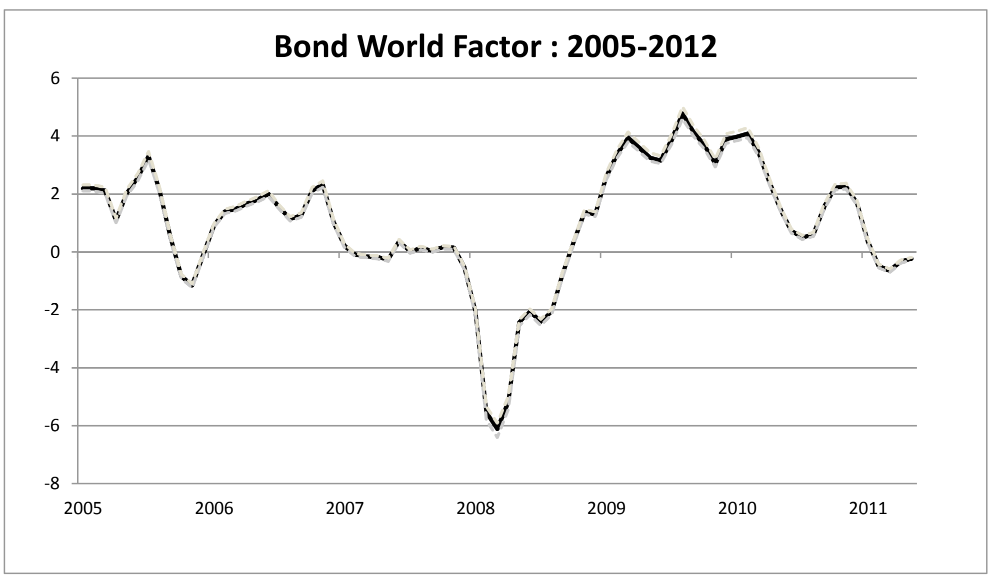


Figure 6: World Factor - Bond

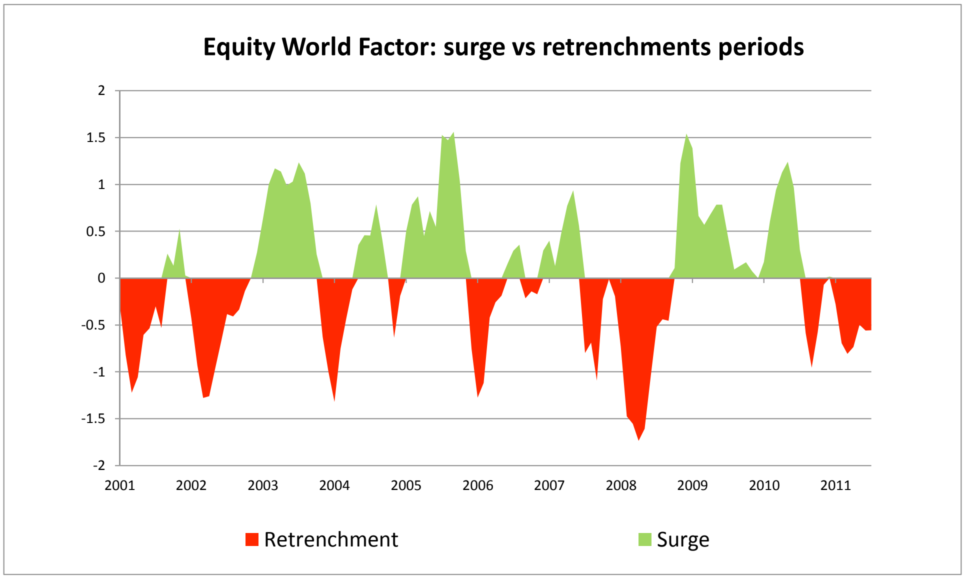


Figure 7: World Factor - Equity

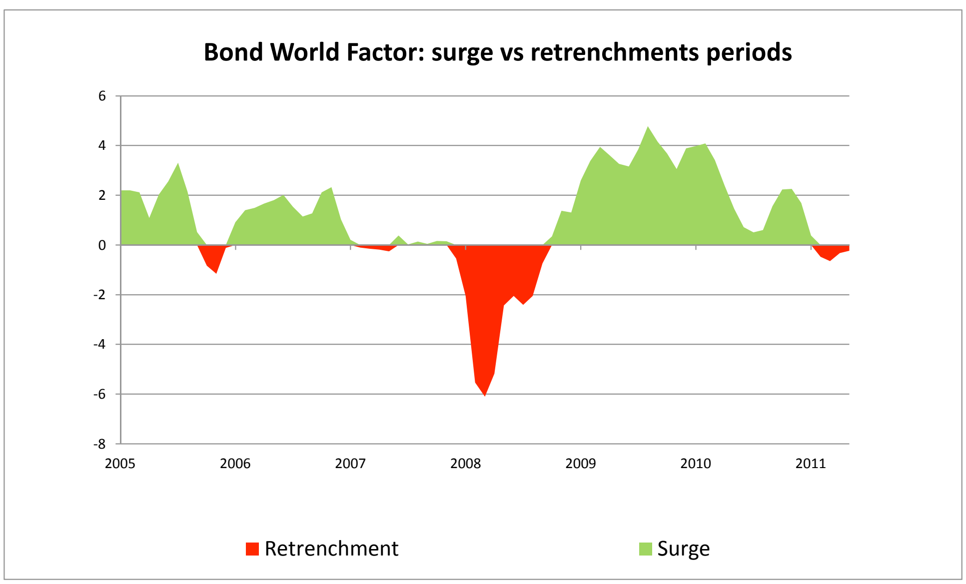


Figure 8: World Factor - Bond

Variables	Full Sample (2001-2011)	Sub-Sample 1 (2001-2007)	Sub-sample 2 (2007-2011)
KCFSI	-0.09*	**-0.5*** **	0.04
ΔKCFSI	**-0.46*** **	-0.29	**-0.53*** **
G10 Economic News	**0.007*** **	0.006*	**0.01*** **
Int. Rates	-0.33**	**-0.87*** **	-0.16
ΔInt. Rates	0.25	0.5	-0.17
constant	0.99**	2.7***	0.35
R-Square	0.26	0.38	0.37
N	126	73	53

*p-values are computed using heteroskedasticity-robust standard errors. *, ** and *** indicate respectively 10%, 5% and 1% significance thresholds.*

Table 3: Equity World Factor - Regression Results

Variables	Full Sample (2005-2011)	Sub sample (2007-2011)
KCFSI	-0.03	-0.03
ΔKCFSI	**-0.3*** **	**-0.29** **
G10 Economic News	**0.004* **	**0.004* **
Global Inflation	**-0.030*** **	**-0.035*** **
constant	0.07	0.08
R-Square	0.43	0.63
N	77	57

*p-values are computed using heteroskedasticity-robust standard errors. *, ** and *** indicate respectively 10%, 5% and 1% significance thresholds.*

Table 4: Bond World Factor - Regression Results

rates become significant at the 1% level. Finally, changes in the level of financial stress and global economic news clearly dominate other regressors over the GFC period. One way to interpret these results is that during normal times, the level of financial stress as well as the level of interest rate - which proxy for both liquidity conditions and the opportunity cost of holding equity over bonds - are guiding equity portfolio flows. On the other hand, in periods of high financial stress, *changes* in financial stress - rather than its level - and economic news in developed economies are more important "signals" for investors. Table 4 confirms this broad picture for the bond world factor for changes in financial stress and economic news remain significant.[26] Interestingly, table 6 also reveals the importance of inflation news in driving bond flows. In particular, unexpected increases in inflation are strongly associated to global bond outflows.

3.2.2 Regional factors

Appendix B reports estimated regional factors using the regional decomposition for which the share of regional variance and the precision of factors is higher. Two findings are noteworthy. First, we find that the neither the geographic paradigm nor the development paradigm substantially improve the performance of the equity model.[27] As a consequence, factors reported in Appendix B are based on the seven benchmark regions. Under this decomposition, we find that although the regional factors are quite precisely estimated for developed Europe, Emerging Europe and Middle East/African countries, the confidence intervals are larger for North America, Latin America and Emerging Asia. This suggests that there is still room to improve the fit of regional dynamics in equity flows. On the other hand, we find that regional bond flows dynamics seem to be better represented by the "development" paradigm. Under this specification, we find that despite a drop in the performance of the model for some advanced countries, the model (i) substantially increases the share of regional variance for almost all developing countries and (ii) yields a precise estimate of the bond flows dynamics in emerging markets. To see this, table 5 below reports the difference in the share of variance explained by the regional factor under the final development grouping and the "benchmark" specification. This finding suggests that although advanced markets are still better represented by the benchmark regional decomposition, emerging markets have a tendency to move altogether, i.e receiving (or losing) bond funding at the same time.

[26] For endogeneity reasons, we took the level of global interest rates out of the bond regression.
[27] Full results available on request.

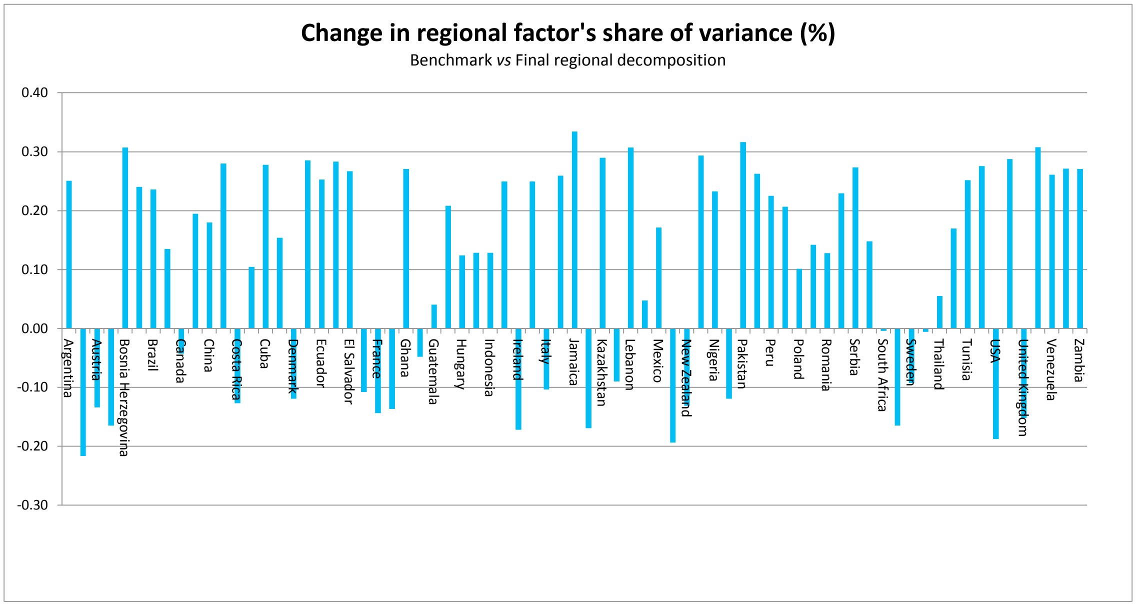


Table 5: Benchmark vs development regional decomposition - Bond Model

3.2.3 Variance decompositions

Building on the factor estimations derived above, we now assess the importance of each factor at the country level using equation (10).[28] Variance decompositions for the full sample of countries are reported in Appendix B. For simplicity, tables 6 and 7 below report only world and regional averages.

Using unweighted averages over the whole sample, we first find that the world factor, the regional factors and the country specific factors explain, respectively, 44 %, 35% and 22% of the overall variance of countries' equity funding and 72%, 18% and 10% of their bond funding. Although the impact of world conditions might be inflated by the presence of the GFC, in particular in the bond sample, these results clearly highlight the quantitative importance of global dynamics in driving portfolio investments. In addition, we also find that world averages conceal a great deal of the cross-country heterogeneity we observe in the full sample. In general, we find that (i) emerging countries display a great dependence on global factors and (ii) advanced economies are mainly impacted by regional dynamics. In the case of equity flows, more than two thirds of emerging markets cross the 50% threshold of variance accounted for by the global factor, and half of them

[28]Note that samples drawn from the Markov chain at each step are not necessarily uncorrelated due to sampling error. Following Kose et al. (2003), we make sure θ_i^w, θ_i^r and θ_i^c sum up to one by orthogonalizing the factors (using the world-region-country factor ordering) when computing the variance decompositions at each replication.

cross the 75% threshold. Some countries - such as Pakistan, Sri Lanka, Indonesia or even Brazil - are close to 90%, implying that 90% of the variability of their equity portfolio funding is due to the changes in the global trend. On the other hand, developed economies, such as Western European countries, are substantially affected by regional dynamics, probably as a result of the high level of trade and monetary integration within the European Union. In fact, only a handful of countries receive (or lose) funding as a result of idiosyncratic dynamics. In the case of equity flows, only 6 countries - Austria, Germany, the USA, Chile, Argentina and Greece - cross the 50% threshold of variance accounted for by country-specific factors, and only two - Switzerland and the USA - in the case of bond flows. In other words, countries with high idiosyncratic influence are either (i) developed countries that are typically regional economic leaders and/or reserve currencies (United States, Germany, Japan, Sweden) or (ii) countries that have experienced one (or more) financial crisis over the period (Argentina or Greece).

Regional averages	World mean	World 0.05	World 0.95	Regional mean	Regional 0.05	Regional 0.95	Country mean	Country 0.05	Country 0.95
North America	14%	13%	15%	38%	14%	67%	48%	19%	72%
Latin America	55%	54%	57%	10%	7%	12%	35%	33%	38%
Western Europe	18%	37%	40%	43%	42%	45%	18%	18%	19%
Eastern Europe	50%	48%	52%	42%	40%	44%	8%	8%	9%
Middle East & Africa	51%	49%	52%	35%	34%	36%	14%	13%	15%
Developed Asia	52%	50%	54%	23%	21%	26%	25%	23%	26%
Emerging Asia	75%	73%	77%	6%	4%	7%	20%	18%	21%
Advanced	27%	26%	29%	46%	43%	50%	27%	23%	29%
Emerging	56%	55%	58%	26%	24%	28%	18%	17%	19%
World (unweighted)	44%	42%	46%	35%	32%	37%	22%	20%	23%

Table 6: Equity Variance Decomposition - Regional Averages

Regional averages	World mean	World 0.05	World 0.95	Regional mean	Regional 0.05	Regional 0.95	Country mean	Country 0.05	Country 0.95
North America	50%	49%	51%	4%	4%	5%	46%	45%	46%
Latin America	76%	75%	78%	19%	17%	20%	5%	5%	5%
Western Europe	57%	55%	58%	29%	28%	31%	14%	14%	15%
Eastern Europe	65%	63%	66%	20%	19%	21%	15%	15%	16%
Middle East & Africa	79%	78%	80%	19%	17%	20%	3%	2%	3%
Developed Asia	82%	81%	83%	4%	3%	4%	14%	13%	15%
Emerging Asia	88%	87%	89%	5%	5%	6%	7%	6%	7%
Advanced	63%	62%	64%	20%	19%	21%	17%	16%	18%
Emerging	76%	75%	78%	17%	16%	18%	7%	6%	7%
World (unweighted)	72%	71%	73%	18%	17%	19%	10%	10%	10%

Table 7: Bond Variance Decomposition - Regional Averages

4 Discussion of the results

4.1 The geography of contagion

Previous variance decompositions have clearly highlighted the extent of co-movement in institutional investor flows. To what extent are these co-movements likened to contagion? and who is affected? Although discussing all the definitions and types of contagion is beyond the scope of this paper,[29] we argue that some of the dynamics we identify reflect more contagion effects than simple interdependence. On the one hand, the existence of an "emerging market" region in the bond model

[29] See Claessens and Forbes (2001) for a review of the different definitions.

implies that all emerging markets tend to lose (or gain) funding at the same time, irrespective of their actual location or macroeconomic environment. Although its quantitative importance seems to be dwarfed by the presence of the GFC in our sample, such an emerging market dynamic is in line with the emergence of emerging market bonds as an asset class *per se,* in which investors herd when in search for yield and retrench from when conditions deteriorate. In addition, this finding would rationalize the fact that spreads on emerging market bonds tend to move in tandem over time, although no clear (bilateral) trade or financial connection exist across these markets[30].

Second, we find that many countries are in fact subject to the "global contagion" channel highlighted recently by Jotikasthira *et al* (2012): using data on global funds, authors found that funding shocks at "home", *i.e* where funds are domiciled, translate into fire sales (and purchases) in countries within the same portfolio, in particular emerging markets[31]. As a result, shocks in "core" countries tend to be propagated to countries in the "periphery", thereby generating surges (stops) in emerging markets when conditions improve (deteriorate) at home. Our results are strongly in line with such a transmission channel: with the exception of a handful of developed markets, the evolution of the portfolio funding of most countries turns out to be driven by shocks originating in the domicile of funds, *i.e* in advanced countries. Developing countries, in particular, happen to be the substantially affected by these "push" effects coming from developed markets. To get a better picture of the geography and intensity of this global contagion, Figures 9 and 10 map the fraction of variance in Equity and Bond funding attributable to the world factor, θ_i^w. For both equity and bonds, the "heat maps" show that the domiciles of funds, i.e advanced countries, are not substantially affected by global waves of inflows (or outflows). On the other hand, emerging markets at the periphery display very high sensitivity levels, both in relative and absolute terms.

4.2 Country Characteristics and Global Contagion Sensitivity

The strength of global contagion in both equity and bond flows naturally raises the issue of the determinants of countries' sensitivity to global shocks. Why are some countries more sensitive to global contagion than others? In other words, what makes investors eager to enter (leave) a country when conditions improve (deteriorate) ? This section addresses this question by investigating the economic features that scale the impact of global conditions at the country level. To do so, we regress the fraction of variance attributable to the world factor, θ_i^w, on a set of 14 structural variables that we group into 6 categories covering a wide range of characteristics : (i) Rule of law

[30]Mc Guire and Schrijvers (2003) found that a single common factor explains approximately 80% of the common variation in a panel of 15 emerging markets bond spreads.

[31]Similarly, Raddatz and Schmukler (2012) found that when some country returns change or crises strike, both investors and managers respond by adjusting their investments substantially in the whole portfolio, thereby transmitting shocks across countries.

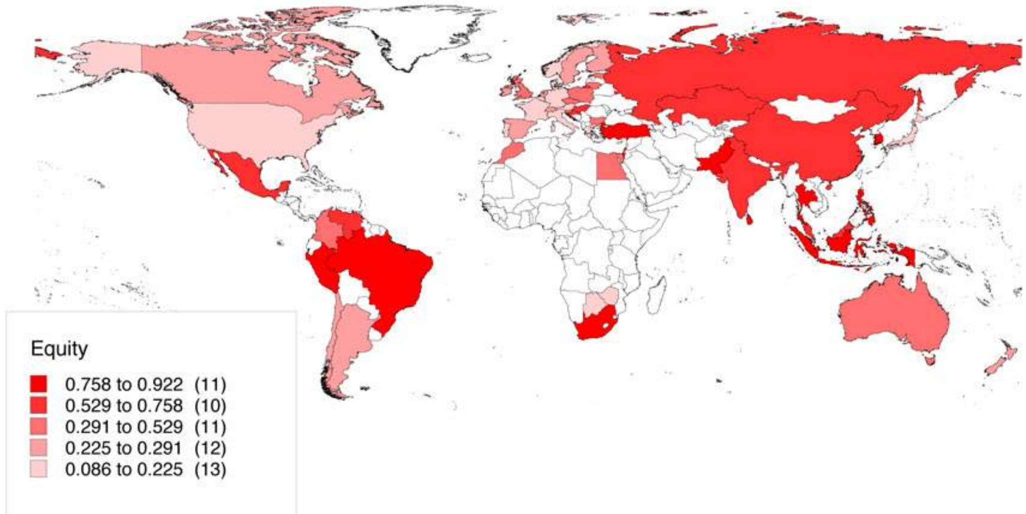
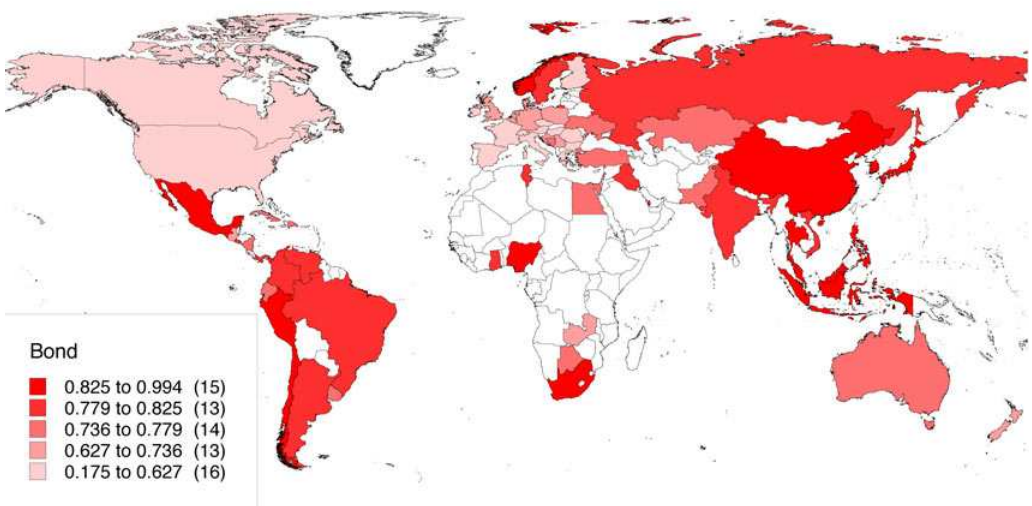


Figure 9: Sensitivity to Global Contagion - Equity flows



Note: values reported in the bottom left panel indicate the range of values for θ_i^w. Numbers in parenthesis indicate the number of countries in each range.

Figure 10: Sensitivity to Global Contagion - Bond flows

and investor protection (ii) Political instability (ii) Transparency, Governance and Accountability at the corporate level (iii) Sound money (iv) Economic risk (v) Public Finance (vi) Distance.

We measure the strength of rule of law, and more generally the strength of investor protection using two different variables: the *rule of law index* from the Economic Freedom of the World database[32] along with the strength of *investor protection* index provided by the International Financial Corporation. Political instability is proxied by the *political risk* rating, which is an index computed by ICRG and assesses the degree of government stability, likelihood of internal (and external) conflict and corruption. The transparency, governance and accountability of economic actors within the country are respectively measured by the *extent of disclosure* index, *extent of director liability* index and the *ease of shareholder suits* index. All of these indexes measure the strength of the outside investor protection against misuse of the corporate assets for personal gain.[33] The strength of money is proxied by the *standard deviation of annual inflation* and the average *real money growth* over the last five years, both proxying for the likelihood of inflation booms affecting asset values. The economic risk is proxied by (i) the past *output volatility* measured by the standard deviation of GDP growth between 1960-2006, (ii) the level of *trade openness* measured as the ratio of exports plus imports to GDP, and (iii) the *GDP per capita.* The level of financial risk is measured using the level *public debt* to GDP and the *budget balance* as % of GDP. Finally, to proxy for the general level of information asymmetry, we use the distance between the investors and the recipient countries. In fact, because an overwhelming majority of fund are located in the US and in Europe, the variable *distance* is an average of the distance between country i and the US (New York) and the distance between country i and Europe (London). Sources, units, and summary statistics are provided for all variables in Appendix A. Finally, qualitative indexes and risk ratings are computed such that a higher value of the variable implies a better assessment in the given dimension.

Although the range of potential variables affecting countries' sensitivity to shocks is vast, we emphasize that these 14 variables span many of the channels that have been highlighted in the existing literature. For instance, Chari and Kehoe (2003) present a model in which countries suffer high capital flow volatility because investors fear expropriation. Alternatively, in the presence of agency frictions, changes in global conditions have been shown to increase the incentives of insiders to take advantage of outsiders, leading external investors to exit countries with lower disclosure and transparency standards. In this vein, Pasquariello (2007) develops a model in which lower

[32] This index combines indicators of judicial independence, contract enforcement, military interference in the rule of law and protection of property rights.

[33] The 3 indicators map different dimensions: transparency of related-party transactions (extent of disclosure index), liability for self-dealing (extent of director liability index) and shareholders' ability to sue officers and directors for misconduct (ease of shareholder suits index). The data come from a survey of corporate and securities lawyers and are based on securities regulations, company laws, civil procedure codes and court rules of evidence. The ranking on the strength of investor protection index is the simple average of the percentile rankings on its component indicators.

information heterogeneity (i.e. more transparency) within a market improves inference about its liquidation values, thus making that market less vulnerable to external shocks. Such a channel would also be consistent with several empirical studies that emphasized the role of transparency as a determinant of fund flows.[34] Investigating the role of distance, seminal empirical finance papers have used gravity models to analyse the determinants of cross-border financial stocks and flows and found that information asymmetries are well captured by geographic distance[35]. As a consequence, one might expect that beside *hard* measure of information imperfection (such as transparency indices), *soft* measures, such as the distance between fund domiciles and the recipient country, might increase flows volatility. Finally, lower global economic growth might jeopardize the ability of agents to repay debtors. Therefore, one could expect countries that are financially fragile and/or historically more dependent on world demand to suffer from pro-cyclical flows insofar as investors expect them to be more affected by the global cycle.

Although considering a wide set of variables enables us to run a "horse race" among these competing channels, the increase in the number of regressors comes at a price. In particular, the limited cross section at our disposal implies that classical regression methods are of limited use in sorting out robust correlates from irrelevant variables. To address this issue, we use two Bayesian model averaging techniques to test the robustness of competing variables: the WALS methodology developed by Magnus *et al* (2010) and the more standard BMA popularized by Sala-i-Martin, Doppelhoffer and Miller (2004) in the context of growth econometrics.[36] Intuitively, the objective of Model Averaging is to address the problem of model uncertainty by (i) running the maximum combination of models (16.000 in our case) and (ii) providing estimates and inference results that take into account the performance of the variable not only in the final "reported" model but over the whole set of specifications. In practice, these two steps boil down to estimate a parameter of interest conditional on each model in the model space and computing the unconditional estimate as a weighted average of the conditional estimates.[37] Tables 8 and 9 below report the results of Bayesian Averaging for both equity and bond regressions. Because we are not interested in the magnitude of the coefficient *per se* but in the sign and the robustness of each regressor, we report only the sign of the coefficients along with two Bayesian criteria: individual Post-Inclusion Probabilities (henceforth PIPs) for BMA and t-ratios for WALS. Magnus et al (2010) suggest a PIP threshold of 0.5 for inclusion of a variable whereas, in the case of WALS, a t-ratio with an absolute value of 1 or greater is typically recommended as a threshold for robustness.[38] Only variables

[34]Ferreira and Matos (2008) show that institutional investors reveal a preference for stocks of countries with strong disclosure standards. Gelos and Wei (2005) who also find that emerging market mutual funds (i) prefer to invest in more transparent countries and (ii) liquidate in priority assets invested in non transparent countries during crises.

[35]See Portes and Rey (2005) and Coval and Moskowitz (1999, 2001).

[36]From a technical point of view, the BMA technique used here follows Fernandez, Ley, and Steel (2001), recently applied in Masanjala and Papageorgiou (2008).

[37]See Magnus *et al* (2010) for an extensive review.

[38]For a discussion of these significance criteria see Magnus *et al* (2010).

that are identified as robust by both methods are considered as robust regressors. To help the interpretation of the results from the Bayesian analysis, table 10 also reports the results of the regression of the Equity (Bond) factor using only the variables identified as "robust".

Using the Bayesian criteria, we find that three criteria - political risk, trade openness and distance - are robust in the equity specification, while only two - political risk and distance - are robust in the bond specification. This finding suggests that investors facing shocks at home tend to modify their exposure to a wide set of countries. However, they do all the more so in "risky" countries. Our results suggest that the level of *political risk* and the *distance* act as the main "risk criteria" in the eyes of fund managers. As a result, sudden surges/stops tend to strike fragile countries, *i.e* emerging markets with unstable political systems and poor connection to the main financial centers.

Equity Sample	BMA		WALS	
Variables	Coeff.	PIP	Coeff	t-ratio
Rule of law	-	0.07	+	0.2
Investor protection	+	0.10	-	-0.73
Political risk	**-**	**1.00**	**-**	**-2.38**
Disclosure index	-	0.12	+	0.71
Manager liability (index)	+	0.14	+	0.76
Shareholder suits (index)	+	0.16	+	0.77
Inflation volatility	+	0.08	-	-0.26
Real money growth	+	0.08	+	0.35
Output volatility	+	0.11	+	0.27
Trade openness	**+**	**0.60**	**+**	**1.50**
GDP per capita	-	0.12	-	-0.94
Public debt	-	0.20	-	-0.97
Budget balance	-	0.07	-	-0.01
Distance	**+**	**0.97**	**+**	**2.60**

Table 8: Equity World Factor sensitivity: Country Characteristics

Bond sample	BMA		WALS	
Variables	Coeff.	PIP	Coeff	t-ratio
Rule of law	-	0.13	+	1.13
Investor protection	+	0.12	-	-0.73
Political risk	-	**0.77**	**-**	**-1.70**
Disclosure index	+	0.20	+	0.71
Manager liability (index)	+	0.08	+	0.76
Shareholder suits (index)	+	0.08	+	0.77
Inflation volatility	-	0.08	-	0.22
Real money growth	-	0.10	+	-1.08
Output volatility	+	0.11	+	0.27
Trade openness	+	0.14	+	0.85
GDP per capita	-	0.21	-	-1.08
Public debt	-	0.09	-	-0.97
Budget balance	-	0.27	+	1.20
Distance	+	**0.99**	+	**2.30**

Table 9: Bond World Factor sensitivity: Country Characteristics

Equity - Robust Variables	Coeff	P-value	Bond - Robust Variables	Coeff	P-value
Political risk	-0.012	0.00			
Trade openness	0.006	0.07	Political risk	-0.007	0.00
Distance	0.024	0.00	Distance	0.009	0.03
R-square	0.56		**R-square**	0.41	
Number of Observations	55		**Number of Observations**	70	

Table 10: Regression Output - Equity (left) and Bond (right)

4.3 Push vs Pull factors in Portfolio investments

A major question running through the capital flow literature is whether the forces that drive capital flows are attributable to external "push" factors or to domestic "pull" factors. Thus far, evidence has been mixed. Calvo, Leiderman, and Reinhart (1993), Chuhan, Claessens, and Mamingi (1998) and Kim (2000) argued that 'push' factors are more important than domestic fundamentals in driving waves of capital inflows and outflows. However, Griffin, Nardari and Stulz (2004) analyzed the role of domestic and global equity market performance argued that both are important in understanding cross-border equity flows. In general, the consensus is that capital flows are driven by "a mix of domestic, contagion, and global shocks" (Forbes and Warnock, 2012). Our results clearly support the presence of strong push factors driving portfolio investments at the global level. In particular, financial stress, macroeconomic news and interest rates in advanced markets seem to be the main source of "push" factors, inducing international investors to increase (or reduce) exposure to foreign markets. However, we also find that structural "pull" factors (such as political stability and distance) determine the exact direction and magnitude of these waves of portfolio flows.

Taken together, these findings are well connected to other empirical contributions that have emphasized the importance of mature market conditions - such as interest rates, liquidity, risk levels or weak economic performance - in generating capital movements.[39] Recently, Ghosh *et al.* (2012) also found that although surges in capital flows to EMEs are driven by push factors, domestic pull factors tend to determine their destination and their magnitudes. On the other hand, they also seriously downplay the relevance of short-term pull factors, such as purely domestic growth/productivity shocks, in driving flows. In our sample, most countries turn out to be dominated by external conditions and only a handful of countries economies - regional economic leaders or countries experiencing a crisis - seem to be driven by idiosyncratic dynamics. In fact, our findings appear more in line with the most recent case studies that find "little or no role for domestic macroeconomic conditions".[40]

Finally, we emphasize that previous push vs pull factor decompositions should be interpreted with caution. After regressing common observed factors on a panel of capital flows, most studies tend to interpret the residuals as a proxy for the importance of pull factors (see in particular Fratzscher (2012)). However, given the importance of regional co-movement in capital flows, such a method tends to interpret as an idiosyncratic dynamic what is in fact the result of regional co-movement. Although these regional dynamics might reflect truly regional "pull" factors (capturing strong regional macroeconomic dynamics, see for instance the case of Western Europe in the equity model), others may simply reflect contagion effects that do not reflect any commonality (e.g emerging markets region in the bond model). Although discussing and estimating the potential bias in existing studies in far beyond the scope of this paper, we stress that the omission of regional dynamics in previous push vs pull factor decompositions probably overestimated the actual impact of pull factors.[41]

[39] Fratzscher (2012) found that during the GFC global shocks (key crisis events, changes to global liquidity and risk measured by the VIX) had a large effect on capital flows during both the crisis and the recovery. Kim (2000) found that capital movements in four developing countries (Mexico, Korea, Chile and Malaysia) was largely due to external reasons such as decreases in the world interest rate and recession in industrial countries. See Forbes and Warnock (2012) for further references on the importance of conditions in large economies in driving capital flows.

[40] See for instance Alper (2000) in the case of Turkey and Mexico, or Kim (2000) for Chile, Mexico, Korea and Malaysia.

[41] Given that, in our sample, some regional factors account for more than 80% of portfolio flows dynamics, the actual bias could be substantial.

5 Conclusion

Using an extensive dataset of fund flows to 81 developed and emerging markets, this paper explored the dynamics and geography of institutional investors flows between 2001 and 2011. Using a factor model in the spirit of Kose, Otrok and Whiteman (2003), we decomposed equity and bond flows into world, regional and idiosyncratic components and highlighted the importance of both global and regional dynamics in institutional investors flows. More importantly, we highlighted a number of "pathological" behaviours of the fund industry, ranging from procyclical lending at the world level to regional and global contagion, with a substantial impact on a vast number of emerging markets.

We conclude by emphasizing that some the findings of this paper raise important additional issues that deserve further attention. First, the patterns of contagion we observe in our sample seem to reflect, to a certain extent, the structure of the financial industry itself. For instance, the intensity of the global contagion might be a sign of the growing importance of so-called global funds who invest both in advanced economies and in emerging markets (Sy and Ong (2013)). In addition, the fact that regional dynamics fit geographical regions in the equity model might be the result of the dominance of regional funds in the equity market, whereas the dichotomy between advanced and emerging markets in the bond model might reflect the dominance of funds with a mandate to invest in either *all* emerging markets or *all* advanced economies (e.g high-yield vs low-yield bond funds). This suggests, in turn, that management rules and portfolio restrictions probably shape the form of contagion.[42] In that case, monitoring the portfolio of major investors could help predicting the way contagion is likely to spread and designing appropriate policy responses. Second, it seems that the rise of institutional investors is coming at a price, including pro-cyclical lending, contagion and spillovers. Our results, in particular, clearly support the view that institutional investors do not act as "deep-pocket" investors at the global level, thereby playing a stabilizing role (in particular buying assets at low prices in crisis times). We argue that this prescribes a better examination of the costs and benefits associated with the rise of the fund industry, in particular with respect to other traditional sources of external funding in emerging markets (such as banks and retail investors).

[42] Note that this issue has recently been touched by Pavlova and Rigobon (2008)

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Appendix A - EPFR Dataset and other definitions

Figures and tables below provide a better overview of the type of funds covered by the EFPR dataset, as well as some useful definitions and computations. Note that when classifying funds in the database, EPFR looks at multiple factors from the prospectus/fact sheet. However, some funds characteristics are imputed to all funds in the EPFR databse, whereas some are not. For instance, all funds have a domicile (as every fund is tied to a company that is based in a specific country), a specific currency, and are classified as either an ETF or a "regular" mutual fund. On the other hand, not all funds in the database are categorized as Retail/Institutional, Active/Passive, benchmark/non-benchmark followers. When this is the case, we report the share of "unclassified funds", i.e the share of funds for which the EFPR did not find enough information to justify a particular classification.

Equity Funds						
	Daily Report		Weekly Report		Monthly Report	
Fund Group	# of Funds	$US Billions	# of Funds	$US Billions	# of Funds	$US Billions
Asia ex-Japan	2 145	272,91	2 150	285,07	2 495	381,25
EMEA	688	45,71	689	46,84	776	55,15
GEM	1 613	436,17	1 621	444,24	1 948	594,53
Global	6 117	1 330,01	6 195	1 377,68	8 448	2 788,76
Japan	793	127,75	779	118,97	858	112,2
Latin America	432	44,71	434	46,11	447	59,67
Pacific	323	48,61	318	47,69	427	81,17
USA	8 057	2 575,99	8 345	2 861,40	10 169	5 312,75
Western Europe	3 876	644,32	3 883	654,82	4 421	822,96
TOTAL	**24 044**	**5 526,18**	**24 414**	**5 882,82**	**29 989**	**10 208,44**

Bond Funds						
	Daily Report		Weekly Report		Monthly Report	
Fund Group	# of Funds	$US Billions	# of Funds	$US Billions	# of Funds	$US Billions
Balanced	1 261	467,23	1 283	486,34	1 856	1 087,34
Emerging Markets	2 217	229,48	2 215	230,59	2 432	339,78
Global	3 997	736,86	4 015	741,61	4 915	1 261,56
High Yield	1 635	347,11	1 657	369,47	1 921	544,97
Money Market	2 274	3 189,95	2 303	3 223,44	2 525	3 479,38
USA	3 604	1 281,63	3 854	1 372,62	4 808	2 735,23
TOTAL	**14 988**	**6 252,26**	**15 327**	**6 424,07**	**18 457**	**9 448,26**

Table 11: EPFR fund coverage, by fund group - Q1 2013

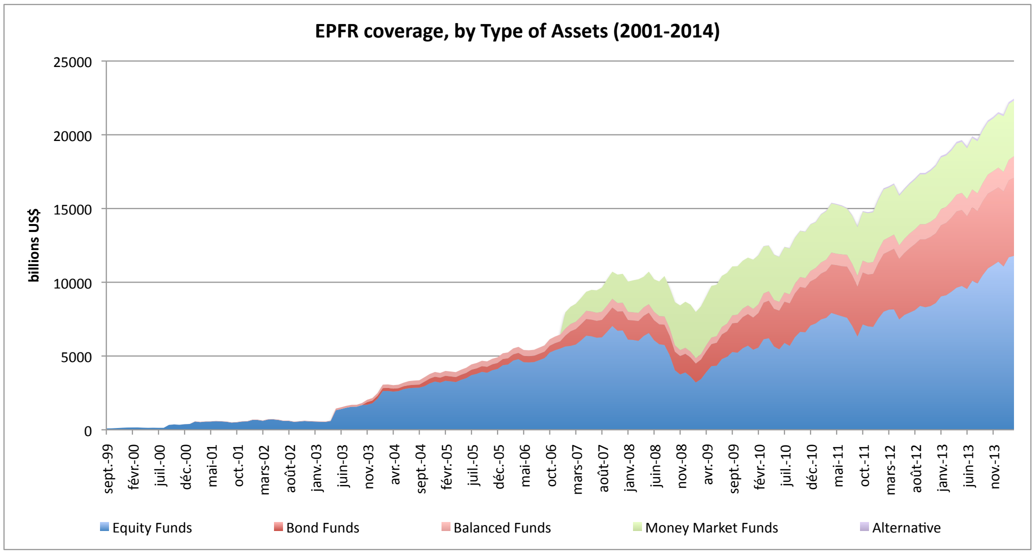


Table 12: EPFR fund coverage by asset type, 2001-2013

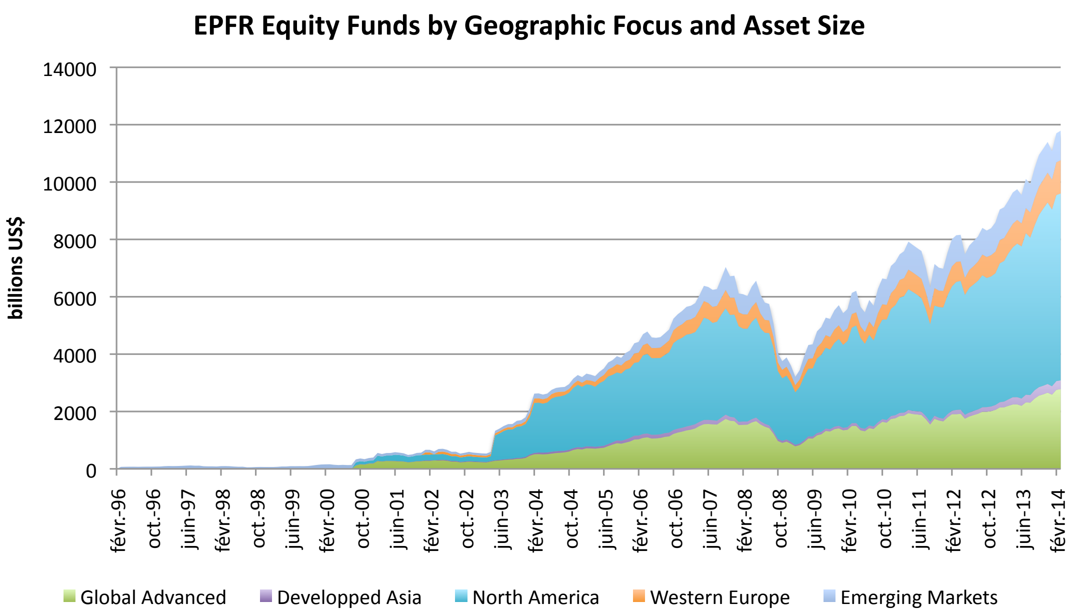


Table 13: EPFR Equity funds by geographic focus, 2001-2013

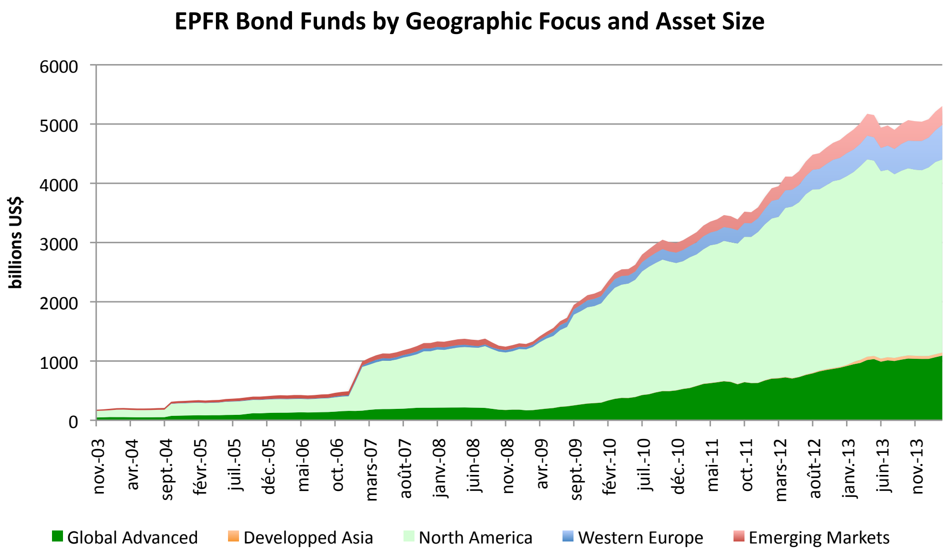


Table 14: EPFR Bond funds by geographic focus, 2003-2013

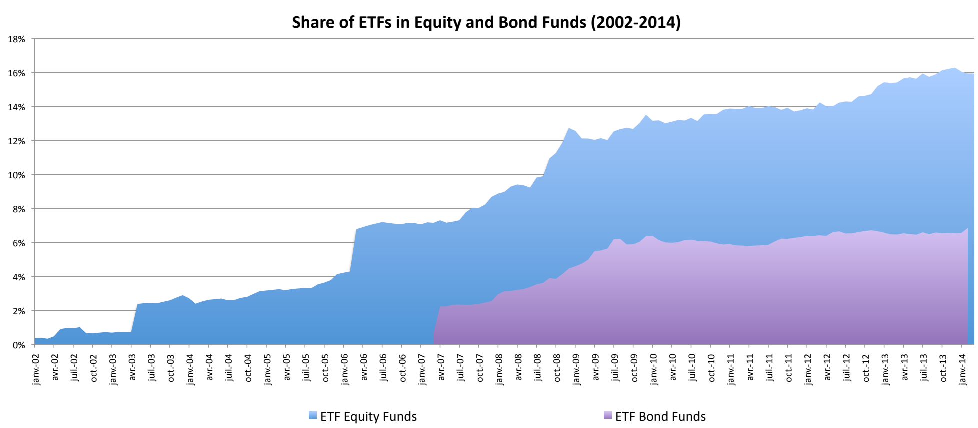
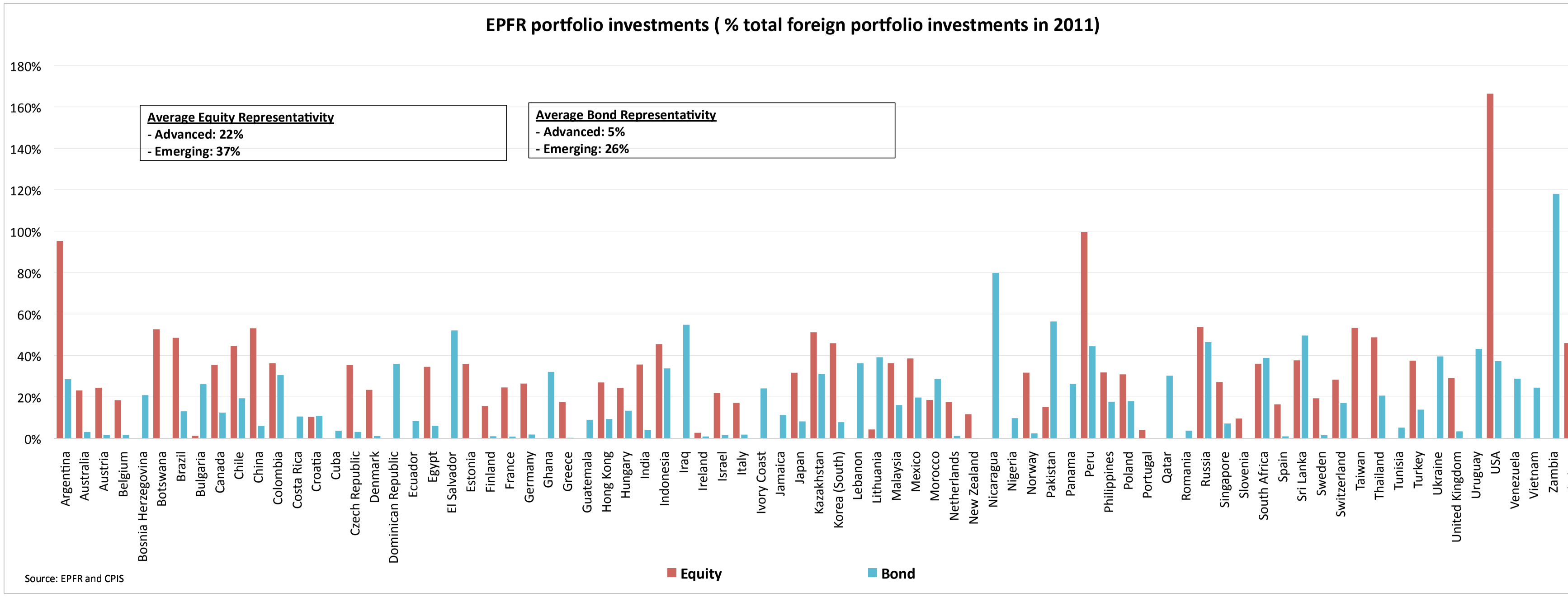
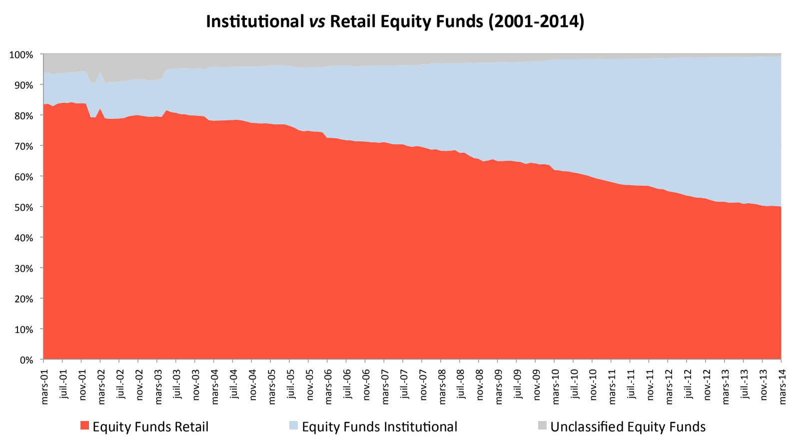


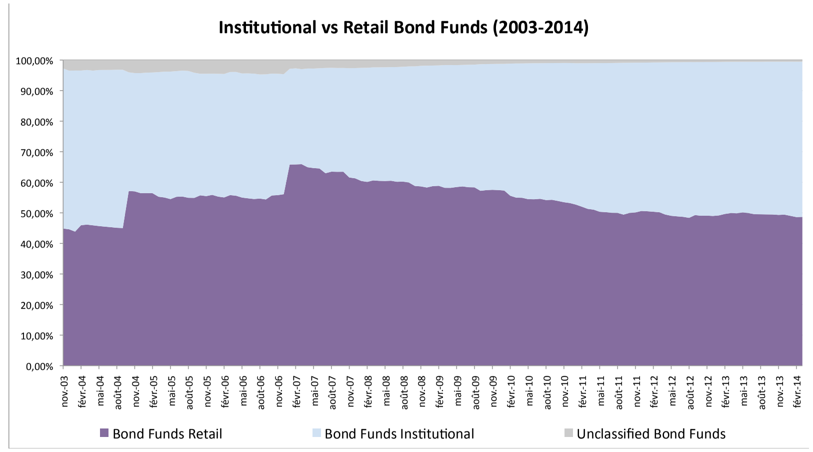
Table 16: EPFR funds - Share of ETFs *vs* Non-ETFs

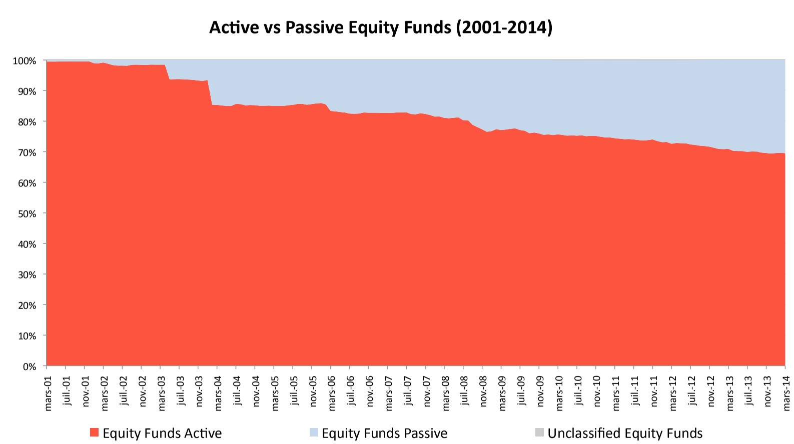


Note that for some countries, the coverage exceeds 100%. This is explained by the presence of funds covered by the EPFR that (i) are located in a given country (ii) have investments in that same country. In this case, equity or bond holdings are not considered as foreign portfolio investments (by CPIS) but are still reported by EPFR. For instance, the presence of a vast number of US domiciled funds with substantial equity holdings within the US explains that the amount of equity portfolio investments covered by EPFR exceeds the amount of foreign equity holdings.

Table 15: EPFR portfolio investments representativity







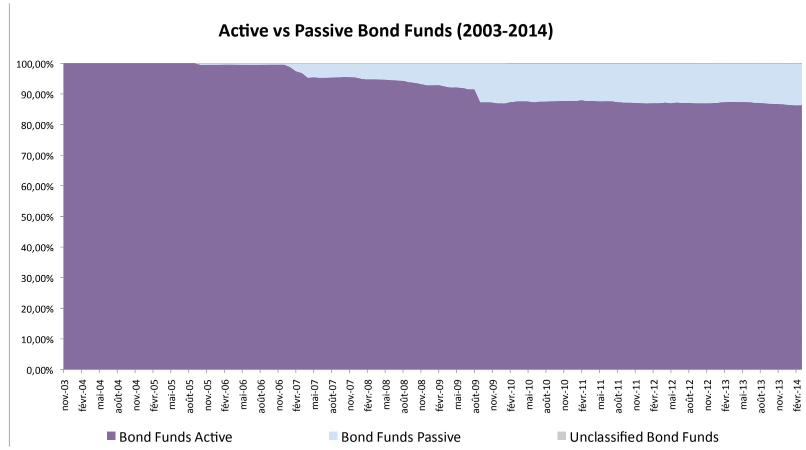


Table 17: EPFR funds - Share of Retail *vs* Institutional, Active *vs* Passive

Note: Funds are defined as “institutional” when the clientele it explicitly caters its services to is made of large institutional investors, such as pension or endowment funds. Multiple factors are used by EPFR factors when classifying funds as “Retail” or “Institutional”. When (i) the fund is explicitly targeted towards institutional investors (ii) the fund has an "I" share class (iii) the minimum investment into the fund is greater than $100,000, then the fund is classified as an institutional fund. To determine whether a fund is actively or passively managed, EPFR Global uses the prospectus/fact sheet, which specifies if the fund is set up to follow a particular benchmark or index. On the other hand, the presence of closed-end bond and equity funds is marginal in the EPFR database. As a result, we do not report the corresponding graphs. Results are available on demand.

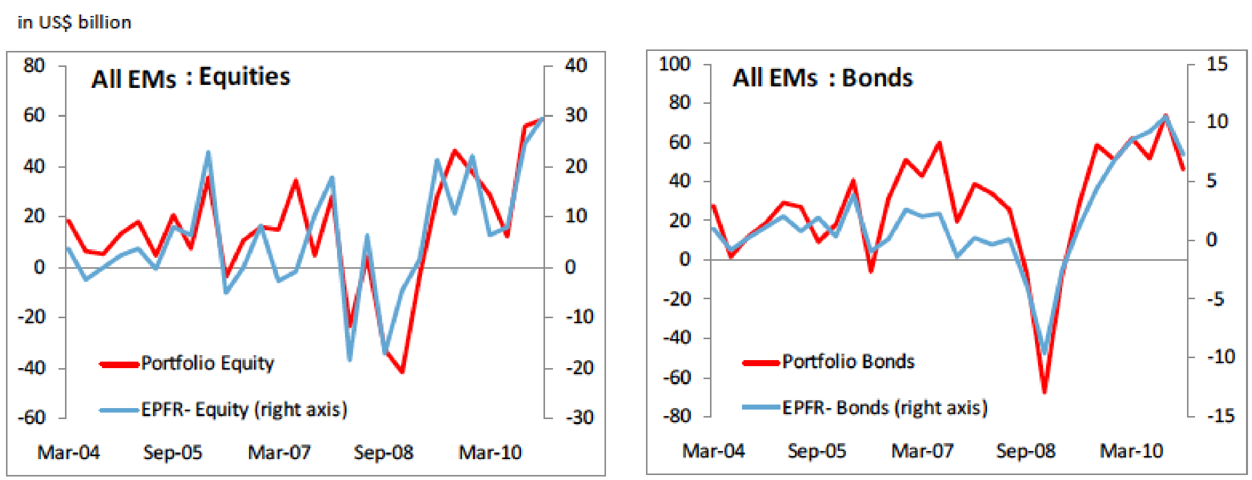


Table 18: Balance of Payments Portfolio flows in Emerging Markets *vs* EPFR recorded flows. *Source: Miao and Pant (2012)*

North America	**Latin America**	**Western Europe**	**Eastern Europe**	**MEA**	**Developed Asia**	**Emerging Asia**
Canada	Argentina	Austria	Bosnia-Herz.	Botswana	Australia	China
United States	Brazil	Belgium	Bulgaria	Egypt	Hong Kong	India
	Chile	Denmark	Croatia	Ghana	Japan	Indonesia
	Colombia	Finland	Czech Republic	Iraq	Korea Rep.	Malaysia
	Costa Rica	France	Estonia	Israel	New Zealand	Philippines
	Cuba	Germany	Hungary	Ivory Coast	Singapore	Sri lanka
	Dominican Rep.	Greece	Lithuania	Kazakhstan	Taiwan	Thailand
	Ecuador	Ireland	Poland	Lebanon		Vietnam
	El Salvador	Italy	Romania	Mauritius		
	Guatemala	Netherlands	Russian Fed.	Morocco		
	Jamaica	Norway	Serbia	Nigeria		
	Mexico	Portugal	Slovenia	Pakistan		
	Nicaragua	Spain	Ukraine	Qatar		
	Panama	Sweden		South Africa		
	Peru	Switzerland		Tunisia		
	Uruguay	U.K		Turkey		
	Venezuela			Zambia		
				Zimbabwe		

Table 19: Compositions of Regions

Appendix B - Supplementary Figures, Tables and Sources

Variable	Source and Date	Unit
Rule of law	Economic Freedom of the World dataset (2000-2005)	Qualitative index from 1 (poor) to 10 (strong)
Investor Protection	International Finance Corporation (World Bank)	Qualitative index from 0 (low) to 10 (high)
Political risk	International Country Risk Guide (ICRG)	Qualitative index from 0 (high risk) to 100 (low risk)
Extent of Disclosure	International Finance Corporation (World Bank)	Qualitative index from 0 (low) to 10 (high)
Extent of Director Liability	International Finance Corporation (World Bank)	Qualitative index from 0 (low) to 10 (high)
Ease of Shareholder suits	International Finance Corporation (World Bank)	Qualitative index from 0 (low) to 10 (high)
Inflation volatility	Economic Freedom of the World dataset (2000-2005)	Qualitative index from 0 (high volatility) to 10 (low volatility)
Real money growth	Economic Freedom of the World dataset (2000-2005)	Qualitative index from 0 (low growth) to 10 (high growth)
Output volatility	WDI	Std deviation of output growth - 1960-2008
Trade Openness	WDI	(Imports+Exports)/GDP
GDP per capita	WDI	in 2005 dollars (PPP Adjusted)
Public debt	WDI	Government debt/GDP
Budget Balance	WDI	Cash surplus/deficit as % GDP
Weighted Distance	Google Maps	Thousands of kilometers

Table 20: Country characteristics - Sources and Units

Note: To avoid any endogeneity issues, real and financial variables - such as real money growth, inflation volatility, public debt levels or trade openness - were introduced in the regression using pre-sample values (i.e using values as of 2001 for Equity regressions, and as of 2004 for bond regression). For qualitative ratings, we used pre-GFC levels (i.e 2005) but tested the robustness of the results using values in 2000 (when available). Results were unchanged.

Variable	Obs	Mean	Std. Dev	Min	Max
Rule of law	76	6.1	2.4	0	9.6
Investor protection	79	5.4	1.6	1.7	9.7
Political risk	78	71.4	12.7	35.5	93.5
Extent of Disclosure	79	5.8	2.75	0	10
Extent of Director Liability	79	4.4	2.47	0	9
Ease of Shareholder suits	79	6.0	2.03	1	10
Inflation volatility	76	7.4	3.23	0	9.9
Real money growth	76	7.7	2.75	0	10
Output volatility	80	4.9	3.9	1.5	24.9
Trade Openness	78	84	53	20	360
GDP per capita	78	16246	14011	1125	74163
Public debt	78	52.88	32	4.6	191
Budget balance	65	-1.19	3.4	-8.3	16.4
Weighted Distance	81	6.9	3.5	2.9	17

Table 21: Country characteristics - Summary statistics

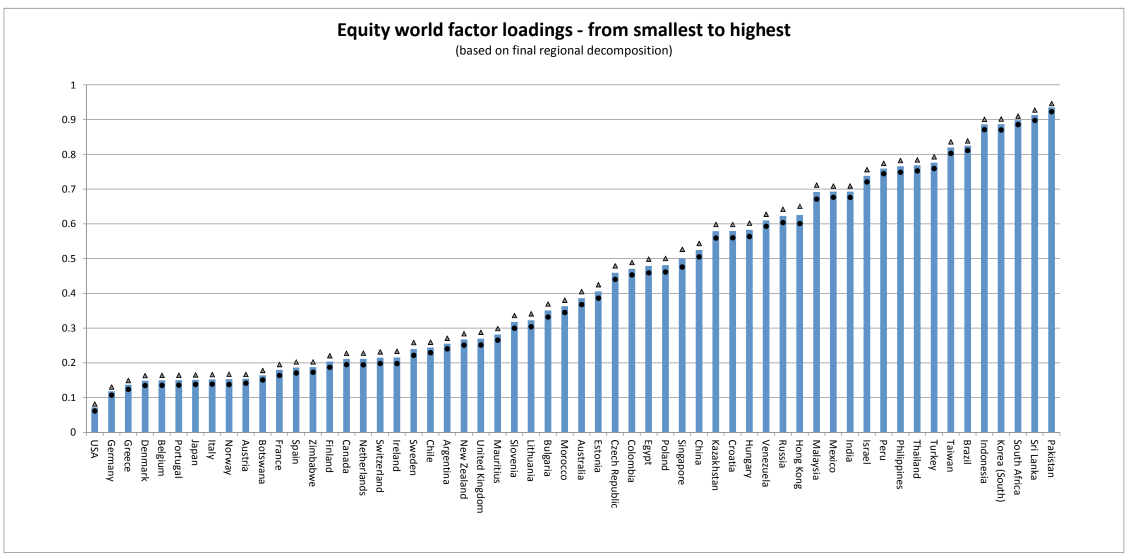


Figure 11: World Factor loadings - Equity model

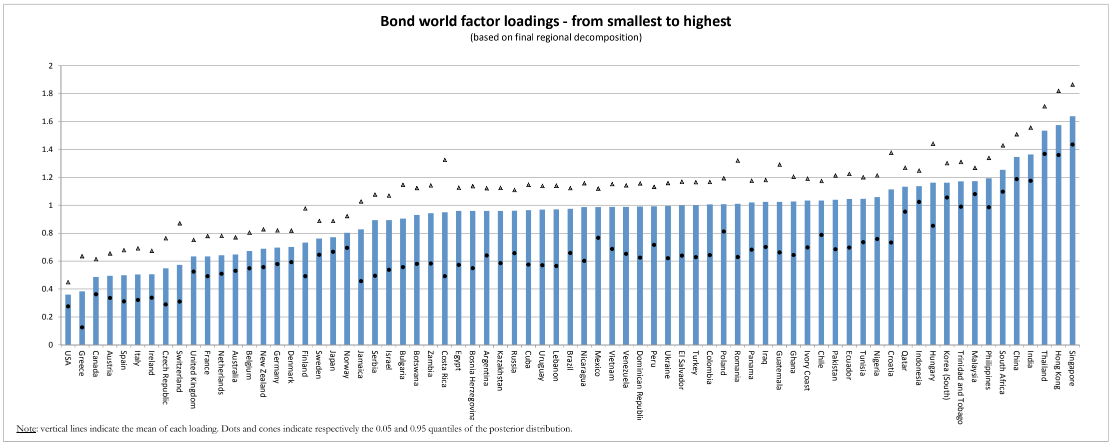


Figure 12: World Factor loadings - Bond model

NB: vertical lines indicate the magnitude of the factor loading. Dots and cones represent respectively the 0.05 and 0.95 quantiles of the posterior distribution.

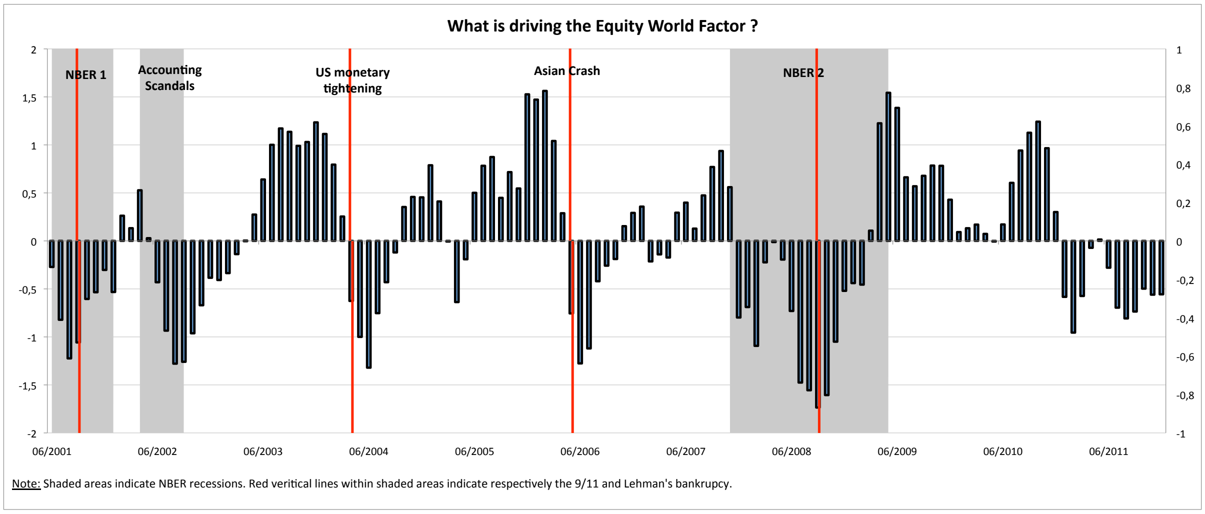


Figure 13: Equity World factor and Financial events

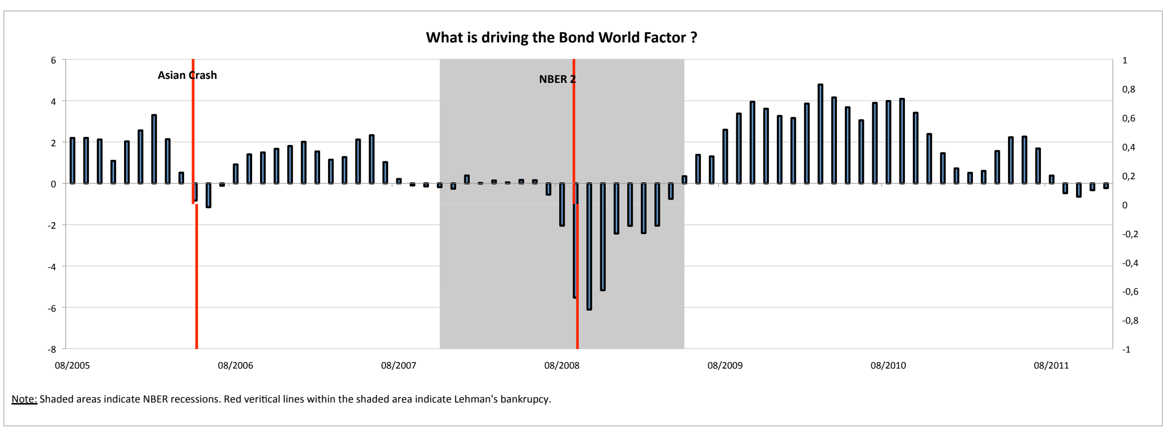


Figure 14: Bond World Factor and Financial Events

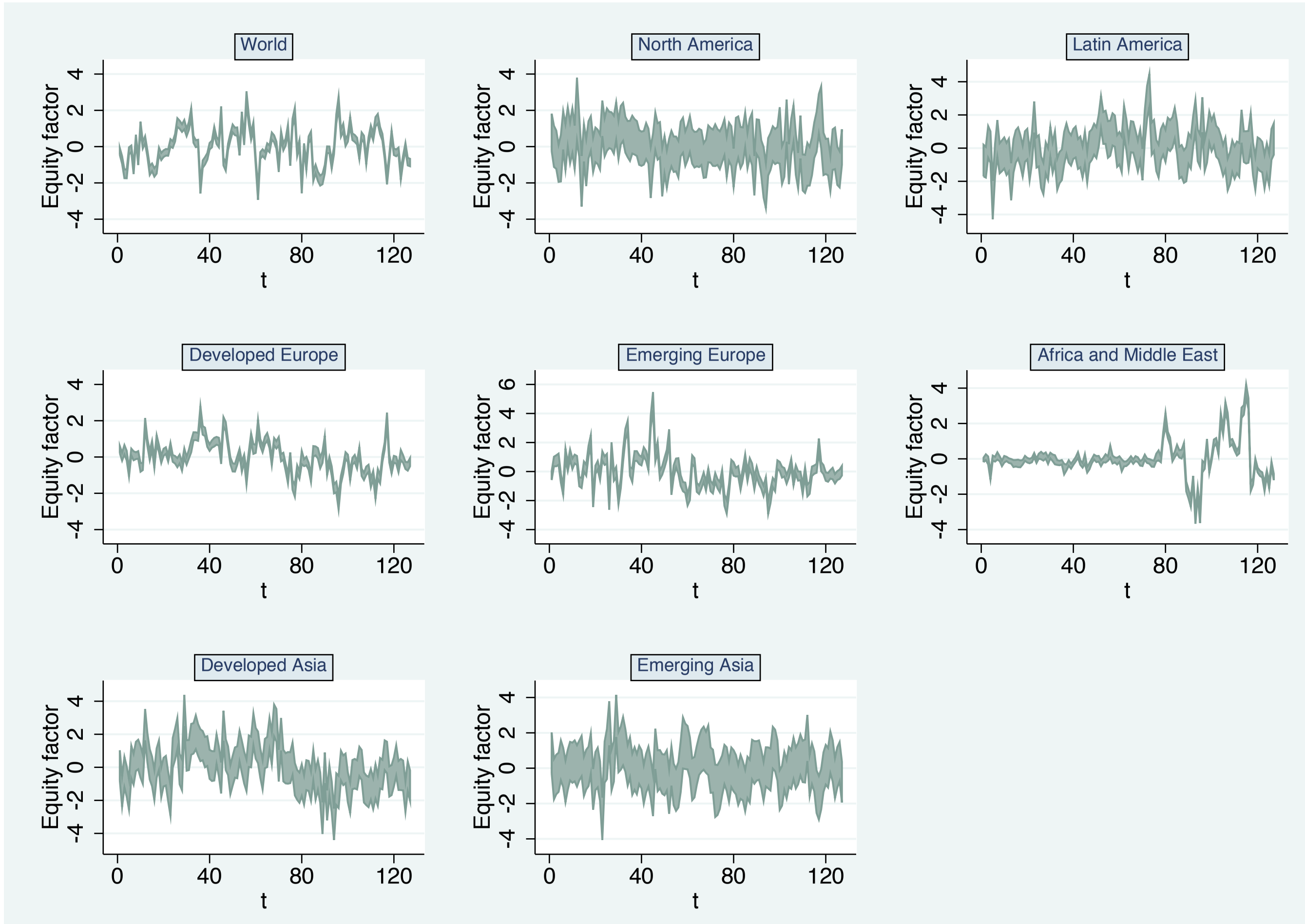


Figure 15: Equity Model: Regional specification

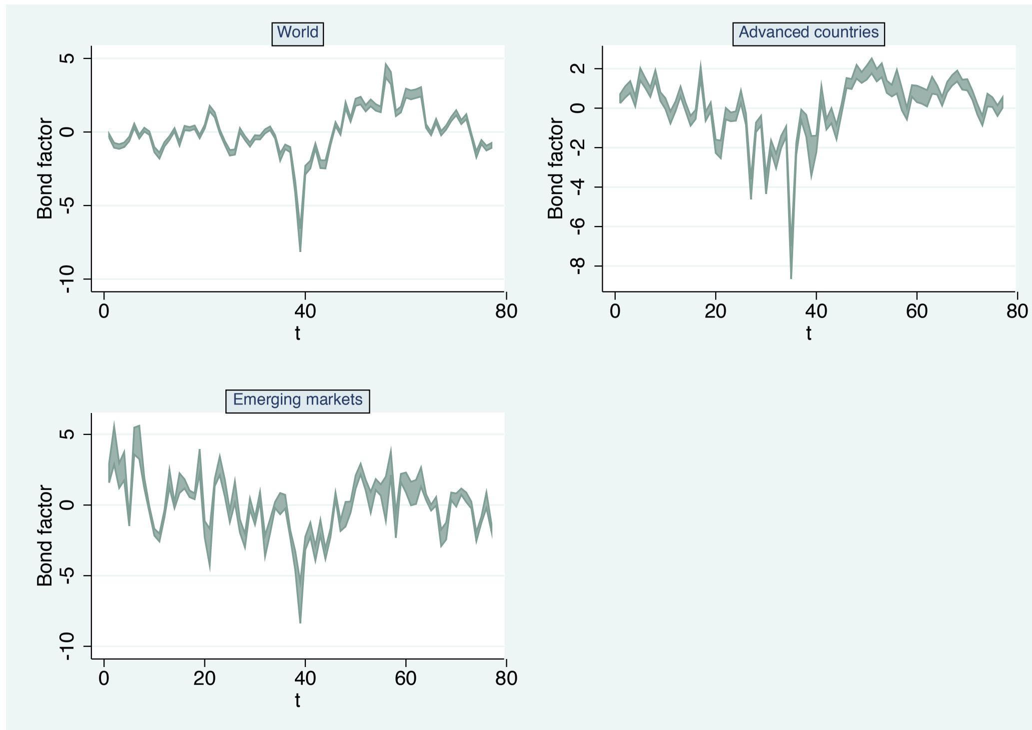


Figure 16: Bond Model: Regional specification

Region	Country	World mean	World 0.05	World 0.95	Regional mean	Regional 0.05	Regional 0.95	Country mean	Country 0.05	Country 0.95
North America	Canada	0.21	0.19	0.23	0.50	0.16	0.76	0.29	0.03	0.63
	USA	0.07	0.06	0.08	0.26	0.12	0.58	0.67	0.35	0.80
Latin America	Brazil	0.83	0.81	0.84	0.10	0.08	0.12	0.07	0.06	0.09
	Argentina	0.26	0.24	0.27	0.01	0.00	0.02	0.74	0.72	0.75
	Chile	0.24	0.23	0.26	0.02	0.00	0.05	0.73	0.71	0.75
	Colombia	0.47	0.45	0.49	0.12	0.08	0.16	0.41	0.37	0.44
	Mexico	0.69	0.68	0.71	0.13	0.10	0.16	0.18	0.16	0.20
	Peru	0.76	0.74	0.77	0.12	0.09	0.14	0.13	0.10	0.15
	Venezuela	0.61	0.59	0.63	0.18	0.14	0.22	0.21	0.17	0.25
Western Europe	Austria	0.15	0.14	0.17	0.24	0.23	0.25	0.61	0.60	0.62
	Belgium	0.15	0.14	0.16	0.68	0.66	0.70	0.17	0.16	0.18
	Denmark	0.15	0.13	0.16	0.50	0.49	0.52	0.35	0.34	0.36
	Finland	0.20	0.19	0.22	0.75	0.73	0.77	0.05	0.04	0.05
	France	0.18	0.16	0.20	0.77	0.76	0.79	0.05	0.04	0.05
	Germany	0.12	0.11	0.13	0.22	0.21	0.24	0.66	0.65	0.67
	Greece	0.14	0.12	0.15	0.22	0.20	0.23	0.65	0.64	0.66
	Ireland	0.22	0.20	0.23	0.78	0.76	0.79	0.01	0.01	0.01
	Italy	0.15	0.14	0.17	0.59	0.57	0.61	0.26	0.25	0.26
	Netherlands	0.21	0.19	0.23	0.73	0.71	0.75	0.06	0.05	0.06
	Norway	0.15	0.14	0.17	0.75	0.73	0.76	0.10	0.09	0.11
	Portugal	0.15	0.14	0.16	0.57	0.56	0.59	0.28	0.27	0.29
	Spain	0.19	0.17	0.20	0.74	0.72	0.76	0.07	0.07	0.08
	Sweden	0.24	0.22	0.26	0.70	0.68	0.72	0.06	0.06	0.07
	Switzerland	0.21	0.20	0.23	0.36	0.34	0.38	0.42	0.42	0.43
	United Kingdom	0.27	0.25	0.29	0.58	0.56	0.60	0.15	0.14	0.15
Eastern Europe	Bulgaria	0.35	0.33	0.37	0.47	0.45	0.49	0.18	0.17	0.18
	Croatia	0.58	0.56	0.60	0.33	0.32	0.35	0.09	0.08	0.09
	Czech Republic	0.46	0.44	0.48	0.52	0.50	0.54	0.02	0.02	0.03
	Estonia	0.41	0.39	0.43	0.52	0.50	0.54	0.07	0.07	0.08
	Hungary	0.58	0.56	0.60	0.41	0.39	0.43	0.01	0.01	0.01
	Lithuania	0.32	0.30	0.34	0.64	0.62	0.66	0.03	0.03	0.04
	Poland	0.48	0.46	0.50	0.51	0.49	0.53	0.01	0.01	0.01
	Russia	0.62	0.60	0.64	0.24	0.22	0.26	0.14	0.13	0.14
	Slovenia	0.32	0.30	0.34	0.63	0.61	0.65	0.06	0.05	0.06
	Kazakhstan	0.58	0.56	0.60	0.20	0.19	0.22	0.22	0.21	0.23
	Turkey	0.78	0.76	0.79	0.12	0.11	0.14	0.10	0.09	0.11
MEA	Botswana	0.16	0.15	0.18	0.82	0.81	0.83	0.02	0.01	0.02
	Egypt	0.48	0.46	0.50	0.10	0.09	0.11	0.42	0.41	0.44
	Israel	0.74	0.72	0.76	0.01	0.01	0.02	0.25	0.23	0.27
	Mauritius	0.28	0.27	0.30	0.70	0.69	0.72	0.01	0.01	0.02
	Morocco	0.36	0.35	0.38	0.37	0.35	0.38	0.27	0.26	0.28
	Pakistan	0.94	0.92	0.95	0.00	0.00	0.00	0.06	0.05	0.08
	South Africa	0.90	0.89	0.91	0.00	0.00	0.01	0.10	0.09	0.11
	Zimbabwe	0.19	0.17	0.20	0.80	0.79	0.82	0.01	0.00	0.01
Developed Asia	Hong Kong	0.63	0.60	0.65	0.29	0.25	0.32	0.09	0.06	0.11
	Korea (South)	0.89	0.87	0.90	0.04	0.02	0.05	0.08	0.07	0.09
	Singapore	0.50	0.48	0.53	0.35	0.30	0.39	0.15	0.12	0.18
	Taiwan	0.82	0.80	0.84	0.06	0.05	0.08	0.12	0.11	0.13
	Australia	0.39	0.37	0.41	0.26	0.24	0.27	0.36	0.35	0.37
	Japan	0.15	0.14	0.17	0.46	0.44	0.47	0.39	0.38	0.40
	New Zealand	0.27	0.25	0.28	0.18	0.17	0.20	0.55	0.54	0.56
Emerging Asia	China	0.52	0.51	0.54	0.15	0.11	0.19	0.33	0.30	0.35
	India	0.69	0.68	0.71	0.05	0.03	0.07	0.26	0.24	0.27
	Indonesia	0.89	0.87	0.90	0.02	0.01	0.03	0.09	0.08	0.10
	Malaysia	0.69	0.67	0.71	0.11	0.08	0.14	0.20	0.18	0.22
	Philippines	0.77	0.75	0.78	0.03	0.02	0.05	0.20	0.19	0.21
	Sri Lanka	0.91	0.90	0.93	0.02	0.01	0.04	0.06	0.06	0.07
	Thailand	0.77	0.75	0.78	0.01	0.00	0.02	0.22	0.21	0.24

Table 22: Equity Variance Decompositions - Full Sample

Region	Country	World mean	World 0.05	World 0.95	Regional mean	Regional 0.05	Regional 0.95	Country mean	Country 0.05	Country 0.95
North America	Canada	0.55	0.54	0.56	0.08	0.07	0.10	0.36	0.36	0.37
	USA	0.45	0.44	0.46	0.00	0.00	0.00	0.55	0.54	0.56
Western Europe	Austria	0.49	0.47	0.50	0.47	0.45	0.48	0.04	0.04	0.05
	Belgium	0.68	0.67	0.70	0.28	0.26	0.29	0.04	0.04	0.04
	Denmark	0.74	0.72	0.75	0.07	0.06	0.08	0.19	0.19	0.20
	Finland	0.48	0.46	0.49	0.42	0.41	0.44	0.10	0.09	0.11
	France	0.60	0.58	0.61	0.38	0.36	0.39	0.02	0.02	0.03
	Germany	0.73	0.72	0.74	0.17	0.16	0.19	0.09	0.09	0.10
	Greece	0.30	0.28	0.31	0.52	0.51	0.54	0.18	0.17	0.19
	Ireland	0.46	0.44	0.47	0.51	0.50	0.53	0.03	0.02	0.03
	Italy	0.45	0.43	0.46	0.54	0.52	0.55	0.02	0.01	0.02
	Netherlands	0.63	0.61	0.64	0.35	0.34	0.37	0.02	0.01	0.02
	Norway	0.85	0.84	0.86	0.05	0.04	0.06	0.10	0.09	0.10
	Spain	0.43	0.42	0.44	0.43	0.41	0.44	0.14	0.13	0.15
	Sweden	0.79	0.78	0.80	0.04	0.03	0.05	0.17	0.16	0.18
	Switzerland	0.18	0.17	0.19	0.03	0.02	0.03	0.80	0.79	0.81
	United Kingdom	0.70	0.69	0.71	0.11	0.10	0.13	0.19	0.18	0.19
Developed Asia	Australia	0.74	0.73	0.75	0.05	0.04	0.06	0.21	0.20	0.22
	Hong Kong	0.82	0.81	0.83	0.03	0.03	0.04	0.15	0.14	0.16
	Japan	0.84	0.83	0.86	0.05	0.04	0.06	0.10	0.10	0.11
	Korea (South)	0.99	0.99	1.00	0.00	0.00	0.00	0.00	0.00	0.01
	New Zealand	0.65	0.64	0.67	0.07	0.06	0.08	0.28	0.27	0.29
	Singapore	0.89	0.88	0.89	0.01	0.01	0.02	0.10	0.09	0.11
Latin America	Argentina	0.78	0.77	0.79	0.20	0.18	0.21	0.02	0.02	0.02
	Brazil	0.80	0.79	0.81	0.20	0.18	0.21	0.00	0.00	0.00
	Chile	0.84	0.83	0.85	0.15	0.14	0.16	0.01	0.01	0.01
	Colombia	0.79	0.78	0.80	0.21	0.20	0.22	0.00	0.00	0.00
	Costa Rica	0.44	0.43	0.45	0.11	0.10	0.12	0.45	0.45	0.46
	Cuba	0.76	0.75	0.77	0.21	0.19	0.22	0.04	0.03	0.04
	Dominican Republic	0.78	0.76	0.79	0.22	0.20	0.23	0.00	0.00	0.00
	Ecuador	0.77	0.76	0.78	0.19	0.18	0.21	0.03	0.03	0.04
	El Salvador	0.78	0.77	0.80	0.20	0.19	0.22	0.01	0.01	0.01
	Guatemala	0.65	0.64	0.66	0.13	0.12	0.15	0.22	0.22	0.22
	Jamaica	0.66	0.64	0.67	0.26	0.25	0.27	0.09	0.08	0.09
	Mexico	0.85	0.84	0.86	0.14	0.13	0.15	0.01	0.01	0.01
	Nicaragua	0.76	0.75	0.78	0.23	0.21	0.24	0.01	0.01	0.01
	Panama	0.80	0.79	0.82	0.20	0.18	0.21	0.00	0.00	0.00
	Peru	0.83	0.81	0.84	0.17	0.16	0.19	0.00	0.00	0.00
	Trinidad and Tobago	0.88	0.87	0.89	0.10	0.09	0.11	0.02	0.02	0.02
	Uruguay	0.77	0.75	0.78	0.23	0.22	0.25	0.00	0.00	0.00
	Venezuela	0.79	0.78	0.81	0.21	0.19	0.22	0.00	0.00	0.00
Eastern Europe	Bosnia Herzegovina	0.75	0.74	0.76	0.24	0.23	0.25	0.01	0.01	0.01
	Bulgaria	0.59	0.58	0.61	0.23	0.21	0.24	0.18	0.18	0.18
	Croatia	0.63	0.61	0.64	0.23	0.22	0.25	0.14	0.14	0.14
	Czech Republic	0.38	0.37	0.39	0.19	0.18	0.21	0.42	0.42	0.43
	Hungary	0.60	0.59	0.61	0.12	0.11	0.14	0.28	0.28	0.28
	Poland	0.70	0.68	0.71	0.10	0.10	0.12	0.20	0.20	0.20
	Romania	0.51	0.49	0.52	0.22	0.21	0.24	0.27	0.27	0.28
	Russia	0.80	0.79	0.81	0.19	0.18	0.20	0.01	0.01	0.01
	Serbia	0.73	0.71	0.74	0.24	0.23	0.26	0.03	0.03	0.03
	Ukraine	0.77	0.76	0.79	0.23	0.21	0.24	0.00	0.00	0.00
Middle East and Africa	Botswana	0.75	0.74	0.77	0.18	0.17	0.19	0.07	0.07	0.07
	Egypt	0.76	0.75	0.78	0.23	0.21	0.24	0.01	0.01	0.01
	Ghana	0.79	0.77	0.80	0.20	0.18	0.21	0.02	0.02	0.02
	Iraq	0.80	0.78	0.81	0.20	0.18	0.21	0.01	0.01	0.01
	Israel	0.73	0.71	0.74	0.24	0.22	0.25	0.04	0.03	0.04
	Ivory Coast	0.80	0.79	0.82	0.19	0.18	0.21	0.00	0.00	0.00
	Kazakhstan	0.76	0.75	0.78	0.23	0.22	0.24	0.00	0.00	0.01
	Lebanon	0.76	0.75	0.77	0.24	0.22	0.25	0.00	0.00	0.00
	Nigeria	0.83	0.81	0.84	0.17	0.16	0.18	0.01	0.01	0.01
	Pakistan	0.78	0.76	0.79	0.21	0.19	0.22	0.02	0.02	0.02
	Qatar	0.87	0.86	0.88	0.10	0.09	0.11	0.02	0.02	0.02
	South Africa	0.87	0.86	0.88	0.02	0.01	0.02	0.11	0.11	0.12
	Tunisia	0.82	0.80	0.83	0.18	0.17	0.19	0.00	0.00	0.00
	Turkey	0.78	0.76	0.79	0.22	0.20	0.23	0.01	0.01	0.01
	Zambia	0.73	0.72	0.74	0.20	0.19	0.21	0.07	0.07	0.07
Emerging Asia	China	0.87	0.86	0.88	0.02	0.02	0.03	0.11	0.10	0.11
	India	0.82	0.81	0.83	0.00	0.00	0.00	0.18	0.17	0.18
	Indonesia	0.94	0.93	0.95	0.05	0.05	0.06	0.01	0.01	0.01
	Malaysia	0.97	0.96	0.97	0.01	0.01	0.02	0.02	0.02	0.02
	Philippines	0.88	0.87	0.89	0.10	0.09	0.11	0.02	0.02	0.02
	Thailand	0.90	0.89	0.91	0.00	0.00	0.00	0.10	0.09	0.11
	Vietnam	0.79	0.77	0.80	0.18	0.17	0.20	0.03	0.03	0.03

Table 23: Bond Variance Decompositions - Full Sample

Chapter II - Growth Slowdowns and the Middle-Income Trap[*]

with Shekhar Aiyar, Romain Duval, Yiqun Wu and Longmei Zhang

This version: *May 2014*

Abstract

The "middle-income trap" is the phenomenon of hitherto rapidly growing economies stagnating at middle-income levels and failing to graduate into the ranks of high-income countries. In this study we examine the middle-income trap as a special case of growth slowdowns. We identify slowdowns as large sudden and sustained deviations from the growth path predicted by a basic conditional convergence framework. We then examine their determinants by means of probit regressions, looking into the role of institutions, demography, infrastructure, the macroeconomic environment, output structure and trade structure. Two variants of Bayesian Model Averaging are used as robustness checks. The results—including some that speak to the special status of middle-income countries—are then used to derive policy implications. [JEL C11, C25, O11, O43, O47]

1 Introduction

Until recently, most of the empirical research on the drivers of economic growth has implicitly assumed growth to be a smooth process, consistent with a wide variety of theoretical models. One strand of the literature, following the lead of Barro and Sala-i-Martin (1991) and Mankiw, Romer and Weil (1992), has examined the determinants of cross-country differences in average GDP per capita growth rates over a long period (typically a decade or more) while another strand, pioneered by Islam (1995) and Caselli, Esquivel and Lefort (1996) has relied on dynamic panels; in either case, what is being estimated is a gradual convergence path under a single (specified or

[*]This version is a shortened version of the IMF working paper reported in the reference list at the end of this chapter. For additional results, graphs and tables, please refer to the original version available on the IMF website.

unspecified) underlying model, with a single coefficient describing the dynamic behavior of a group of countries.[1]

Yet as documented by Easterly and others (1993) and many others since then, growth dynamics is very unstable in the real world, even at low frequencies. Why this is so remains to be fully understood theoretically. In principle, it could simply be that there are large and frequent shifts in the drivers of growth such as policies and institutions, with transitory—in an underlying neoclassical model—or permanent—under an endogenous growth model—effects on growth. This seems a partial explanation at best, however, as panel growth regressions are typically unable to account for the bulk of the within-country variation in growth rates. Another, non-exclusive explanation could be that a single underlying model is not an appropriate representation of the growth process for all countries at all time. Indeed, a number of theories imply the possibility of shifts between growth regimes, such as for instance models with poverty traps or that allow for multiple technologies more broadly. On the empirical side, following Pritchett's (2000) call for more attention to "the hills, plateaus, mountains and plains" as a key source of variation in the data, a literature has arisen that attempts to explore (sustained) growth turning points. For instance, Hausman, Pritchett and Rodrik (2005) explore growth accelerations, Jermanowski (2006) examines transitions between different growth regimes in a Markov-switching framework, and Hausman, Rodriguez and Wagner (2006) study of growth collapses.

The present paper contributes to this literature, focusing on growth slowdowns. Policy makers are often more interested in the risks and opportunities arising from growth turning points than in the very long-run drivers of growth. And in practice, anxiety about growth slowdowns has been particularly acute in middle-income countries. Growing attention has been devoted in policy debates (see e.g. Commission on Growth and Development, 2008) to the risk of a "middle-income trap", which may simply be defined as the phenomenon of hitherto rapidly growing economies stagnating at middle-income levels and failing to graduate into the ranks of high-income countries. Insofar as such a "trap" actually exists, several Latin American economies would seem to have fallen into it in the past, having failed to achieve high-income levels despite growing rapidly and attaining middle-income status several decades ago. By contrast, several East Asian economies, the so-called "tigers", have in recent decades escaped the trap, continuing to grow rapidly after attaining middle-income status, and eventually attaining per capita income levels comparable to advanced countries. A key policy issue is whether today's fast-growing middle-income Asian economies, including China, possibly India and several ASEAN countries, are more likely to emulate the former or the latter trajectory. The issue has assumed particular urgency in the face of recent slowdowns in several major emerging economies across diverse geographical regions: not just the Asian giants, but also

[1] Following the work of Im, Pesaran, and Shin (2003), some studies have allowed the convergence co-efficient to diverge across countries. But again, for each country the idea is that a single co-efficient adequately captures the dynamical process, and that this co-efficient is the object most worthy of study.

Brazil or South Africa.

Yet clear theoretical foundations for the existence of a middle-income trap have yet to be developed, and empirical evidence so far is also very limited. One broad theoretical argument emphasizes the roles of imitation as the main driver of technological catch-up at early stages of development and of innovation at a later stage (e.g. Perez-Sebastian, 2007), with innovation requiring more complex and harder-to-implement framework conditions, such as e.g. high-quality innovation, regulatory or tertiary education policies (Commission on Growth and Development, 2008). A related argument involves multiple equilibria, in the spirit of past models developed for poverty traps, with the growth path of the economy being driven by the availability of certain key inputs or policies required for innovation-driven growth (e.g. Agenor and Canuto, 2012). On the empirical side, the only available research is Eichengreen, Park and Shin (2011, 2013), who for a sample of fast-growing middle-income economies with GDP per capita levels exceeding (2005 PPP) US$10,000 find that slowdowns have occurred most frequently at income levels in the $10,000-$11,000 and $15,000-$16,000 ranges, in both cases before countries reached high-income status.

In this paper, we study empirically the middle-income trap as a special case of growth slowdowns, and attempt to make several contributions to the literature on growth turning points. First, we propose a clear identification procedure for growth slowdowns, one that takes theory seriously rather than simply relying on structural breaks in the time series patterns of economic growth. Second, having identified slowdowns, we show that these episodes are indeed disproportionately likely to occur in middle-income countries, thereby providing empirical justification for policy concerns about the middle-income trap. Finally, the paper attempts to identify the determinants of growth slowdowns in a systematic way. Acknowledging the wide uncertainty surrounding the determinants of growth—and, by implication, of growth slowdowns—it relies on a comprehensive set of explanatory variables and seeks to validate standard probit results using two variations of Bayesian model selection —applying to growth turning points the kind of approach that has been applied to growth rates in the past, e.g. by Sala-i-Martin, Dopplehofer and Miller (2004). This enables us to identify the robust correlates of growth slowdowns and how these differ between middle-income and other countries. We find that several dimensions of institutions, the macroeconomic environment, demography, output and trade structure and infrastructure are important drivers of the risk of a sustained growth slowdown. Middle-income countries differ from the broad sample in key respects, e.g., deregulation and infrastructure are found to be disproportionately important in reducing the risk of a slowdown.. These results are then used to derive policy implications, with a special emphasis on fast-growing Asian economies.

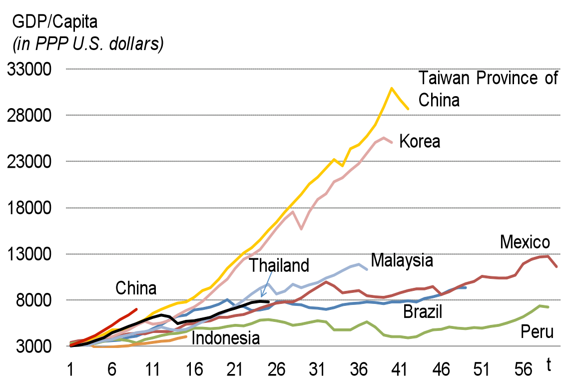
The remainder of this paper proceeds as follows. Section I shows some stylized facts for a selected group of Asian and Latin American countries to illustrate how heterogeneous growth paths can be, and why growth slowdowns and stagnation at middle-income levels is of such policy relevance.

Section II describes and executes our identification procedure for growth slowdowns and examines whether middle-income countries are indeed at greater risk of undergoing such slowdowns. Section III outlines our methodology for exploring their determinants and presents a selection of empirical results. On this basis, Section IV draws some policy conclusions for fast-growing Asian economies.

2 Some Stylized Facts

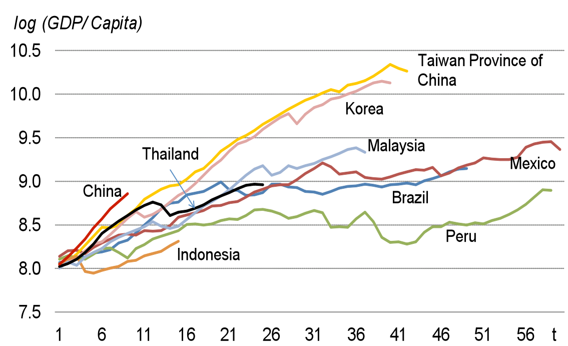
The contrast between several successful East Asian economies and some unsuccessful Latin American economies in the past is illustrated in Figure 1, which shows the evolution of GDP per capita relative to U.S. levels for a set of countries once they have reached an income level of US$ 3000.[2] Latin American countries such as Mexico, Peru, and Brazil reached that level before any of the other countries in the chart, hence the longer time series for those countries and the higher intercepts (since U.S. per capita income, the denominator, is smaller the further back in time we go). Despite their relatively late start, two of the Asian "Tigers," Korea and Taiwan Province of China have progressed rapidly, increasing their per capita income from 10-20 percent of U.S. levels to 60–70 percent of US levels.[3] In stark contrast to this rapid income convergence, the Latin American countries have stagnated (Brazil and Mexico) or even fallen behind (Peru) in relative terms. The recent performance of a set of middle-income countries in Asia lies somewhere between the extremes of East Asia and Latin America. Therefore the policy challenge there is to ensure that going forward the former trajectory is emulated, not the latter.

Figure 1. Cross Country Comparison[1]



[1] t=0 is defined as the year when the GDP per capita for a particular country reached 3000 U.S. dollars in PPP terms.

Figure 2. Growth Trajectories[1]



[1]The GDP per capita is in constant 2005$ PPP adjusted and t= years on X axis. t=0 is defined as the year when the log(GDP/capita) for a particular country reached US$ 3000 in PPP terms.

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[2]GDP in constant 2005 international dollars is obtained from the Penn World Tables 7.1. In this section US$3000 is chosen as an illustrative threshold for middle-income countries; the next section will develop the definition of a middle-income country more carefully.

[3]Hong Kong SAR and Singapore (and among Latin American countries, Argentina) are not shown in these charts because they had already exceeded the threshold level of US$3000 per capita in 1960, when our time series begins.

There seems to be a connection between experiencing a growth slowdown and falling into a middle-income trap. Figure 2 shows the same data in log income terms, so that the slopes of the lines can be read as growth rates. It appears that the Latin American countries generally grew at a fairly brisk pace for two or more decades after attaining middle-income status. But there is a noticeable slowdown after that, with correspondingly rapid divergence from the East Asian trajectory. In order to look in greater depth into the drivers of growth slowdowns, Figures 3 and 4 decompose GDP growth rates (in constant international dollars) into factor accumulation and TFP growth, for different regional groupings.[4] Steep falls in TFP growth appear to have played an important role in past growth slowdowns across Latin America in the 1980s, with lower growth in physical capital stocks also contributing (Figure 3). In contrast, the success stories of East Asia (and, much more recently and thus far, China and India) are largely underpinned by robust TFP growth, especially in China and Taiwan Province of China, where they accounted for more than half of all GDP per capita growth (Figure 4).

Figure 3. Slowdown in Latin America: 1970s vs. 1980s

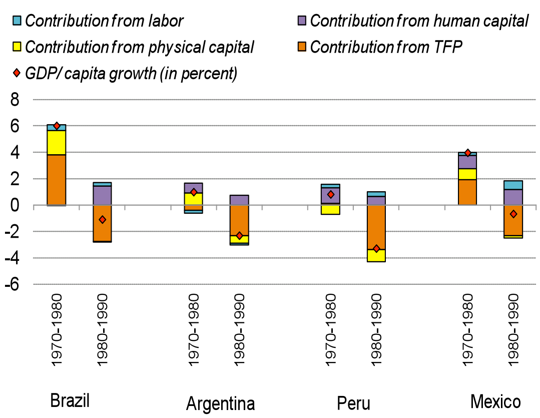
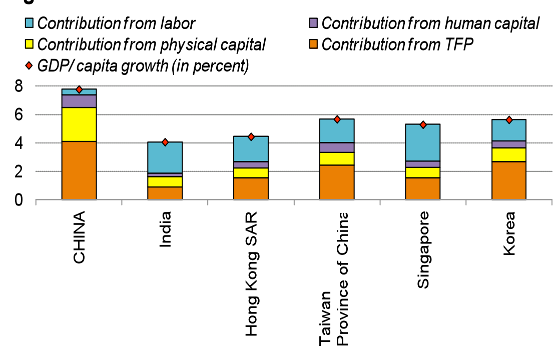


Figure 4. Growth Success in Asia



Note: For the four tigers, the starting date is 1970, by which time GDP per capita had exceeded US$ 3000 in PPP terms in each country. For the later growth miracles, China and India, the reference period is chosen to start roughly with economic liberalization: 1970-2009 for China, 1980-2009 for India.

[4] Physical capital stocks are calculated on the basis of the perpetual inventory method from the Penn World Tables. A standard capital share of one-third is assumed (see Gollin, 2002; and Aiyar and Dalgaard, 2009 for justification). Human capital is calculated as a weighted average of years of primary schooling, years of secondary schooling and years of higher schooling from the Barro-Lee dataset, with the weights comprising Mincerian coefficients obtained by Psacharopuolos (1994). The original idea that this is the appropriate way to introduce human capital into an aggregate production function comes from Bils and Klenow (2000). Here we follow the lead of several papers (Hall and Jones (1999); Aiyar and Dalgaard (2005); Duval and Maisonneuve (2010)) in assuming a piecewise linear formulation for the log of human capital per capita, with the coefficients taken from Psacharopoulos (1994).

3 Are Middle-Income Countries at Greater Risk of Sustained Growth Slowdowns?

3.1 Identifying Growth Slowdowns

The literature on growth slowdowns has mainly focused on using statistical techniques to identify turning points in the growth series of a sample of countries, or applying intuitive rules of thumb. As an example of the former, Ben-David and Papell (1998) examine a sample of 74 advanced and developing economies over several decades and look for statistically significant breaks in time series of GDP growth rates. More recently, Berg, Ostry and Zettlemeyer (2012) identify growth spells by employing and extending an algorithm suggested by Bai-Perron (2003).

As an example of the rules of thumb approach, Hausmann, Rodriguez, and Wagner (2006) develop a rule of thumb for identifying "growth collapses," which are defined as episodes which start with a contraction in output per worker and end when the value immediately preceding the decline is attained again. Eichengreen, Park, and Shin (2011), define a growth slowdown episode as one in which three conditions are satisfied: (i) growth in the preceding period is greater than or equal to 3.5 percent per annum; (ii) the difference in growth between the current and preceding period is greater than or equal to 2 percentage points per annum; and (iii) the country's per capita income exceeds US$10,000 in 2005 constant international prices. This work, in turn, is symmetrically based on Hausmann, Pritchett, and Rodrik's (2005) analysis of growth accelerations.

This study adopts an alternative approach, one that is better grounded in growth theory. The standard Solow model with identical rates of savings, population growth, depreciation and technological change across countries predicts that poor countries will grow faster than rich countries. Conditional convergence frameworks emphasize that these parameters, and other variables that might influence the steady state, are likely to differ across economies, thus implying that different economies converge to different steady states. Nonetheless, conditional on these country-specific factors, economies further away from the world technology frontier should grow faster than economies close to the frontier. Our approach is to operationalize these strong predictions from basic growth theory, and identify slowdowns in terms of large sudden and sustained deviations from the predicted growth path.

We use annual data on per capita income in constant 2005 international dollars to compute a five year panel of GDP per capita growth rates.[5] The sample covers 138 countries over 12 periods (1955–2009). Our specification is parsimonious: per capita GDP growth is regressed on the lagged income level and standard measures of physical and human capital.[6] For any country at any given

[5] We use five-year rolling geometric averages.

[6] This represents the most parsimonious established framework for conditional convergence using panel data. It

point in time, the estimated relationship yields a predicted rate of growth, conditional on its level of income and factor endowments.

Define residuals as actual rates of growth minus estimated rates of growth. A positive residual means that the country is growing faster than expected, while a negative residual means the reverse. Then country i is identified as experiencing a growth slowdown in period t if the two following conditions hold:

$$res_t^i - res_{t-1}^i < p(0.20) \qquad (1)$$

$$res_{t+1}^i - res_{t-1}^i < p(0.20) \qquad (2)$$

Here p (0.20) denotes the 20th percentile of the empirical distribution of differences in residuals from one time period to another. Intuitively, condition (1) says that between period t-1 and t the country's residual became much smaller, that is, its performance relative to the expected pattern deteriorated substantially. To be precise, the deterioration was sufficiently pronounced to place the country-period observation in the bottom quintile of changes in the residual between successive time periods. The second condition is meant to rule out episodes where growth slows down in the current period only to recover in the next, by examining the difference in residuals between periods t-1 and t+1, that is, over a ten year period.[7] We are interested here in countries which experience a sustained slowdown.

This methodology has at least three desirable characteristics. First, it makes precise the relative nature of growth slowdowns. At different points in time, the neo-classical growth framework predicts different growth rates for different countries conditional on world technology, current income and factor endowments. By identifying growth slowdowns relative to these factors, and also relative to other economies, the methodology takes theory seriously. Second, and relatedly, it clarifies what needs to be explained. A slowdown in the headline rate of growth could occur, for example, because the country has already attained a high level of income, or because of a temporary shock. But neither of these phenomena stand in need of explanation. Our proposed methodology demarcates those countries which are growing slowly after accounting for expected income convergence and after accounting for short-lived shocks. Finally, the methodology appears

also allows a sharper focus on TFP; what we describe as growth slowdowns in this paper may alternatively be characterized as TFP slowdowns. The rate of investment in physical capital is taken from the Penn World Tables. The rate of investment in human capital across countries is unavailable, so we follow the standard practice of using the stock of human capital instead (e.g., Islam, 1995; Caselli, Esquivel, and Lefort, 1996), calculated using the methodology described in the previous section. Full results are available from the authors on request.

[7] Note that these conditions imply that we cannot identify slowdowns in our sample's initial period (1955–60), because there is no prior period for comparison, nor in the final period (2005–09), because there is no subsequent period for comparison.

to pass the "smell test." In particular, it captures the episodes that motivated this study, that is, substantial growth slowdown episodes in Latin America in the 1980's and some slowdowns in Asian countries in the late 1990's (for the comprehensive list of all country-periods identified as slowdowns by our methodology, see Aiyar and others, 2013).

A variant of our specification in which the initial panel regression excludes factors of production as regressors, retaining only the initial level of income (absolute convergence), yields a rather similar set of slowdown episodes (the correlation coefficient is 0.97). This implies that the results from this paper are not sensitive to the particular form of conditional convergence assumed above. It also suggests, as already flagged above, that when it comes to sustained shifts away from the convergence path, growth slowdowns are almost synonymous with TFP slowdowns. However, both the conditional and absolute convergence frameworks differ markedly from Eichengreen, Park, and Shin (2011). The latter study, for example, does not capture the widespread slowdown across Latin America in the 1980s, perhaps because of its narrower focus on countries which already had already attained a per capita income of US$ 10,000 in 2005 international dollars. In fact most countries identified in that paper are developed and oil exporting countries. Our methodology focuses instead on slowdowns at all income levels relative to the predictions of growth theory, allowing us to ask in a second stage whether slowdowns are empirically more prevalent in middle-income countries.

Tables 1 and 2 below summarize the slowdown variable created using this identification scheme, breaking down episodes by region and time period. Out of the 1125 observations collected in the dataset, the algorithm in (1)-(2) selects 123 slowdowns, that is, around 11 percent of the overall sample. Two important stylized facts stand out. First, the regional frequency of past episodes— measured as the ratio of slowdown episodes to overall number of observations in the region— was significantly higher in developing regions, in particular Latin America, Middle East, North Africa, sub-Saharan Africa, and East Asia (Table 1). It was also higher in some developing regions than in others. Second, the frequency of experiencing a slowdown differed from period to period (Table 2). In particular, the frequency of slowdowns was higher than average over 1975–85, and rather low during 1960–65.

Slowdown variable	Advanced	East Asia and Pacific	Europe and Central	Latin America and the	Middle East and	South Asia	Sub-Saharan Africa	Total
0	205	130	79	181	107	58	242	1,002
1	10	17	4	33	22	3	34	123
Total	215	147	83	214	129	61	276	1125
Slowdown Frequency (in percent)	5	12	5	15	17	5	12	11

Table 1: Distribution of Slowdown Episodes by Region

Slowdown Variable	1960-65	1965-70	1970-75	1975-80	1980-85	1985-90	1990-95	1995-00	2000-05	Total
0	97	114	106	98	90	122	125	125	125	1002
1	2	6	14	22	30	10	13	13	13	123
Total	99	120	120	120	120	132	138	138	138	1125
Slowdown Frequency (in percent)	2	5	12	18	25	8	9	9	9	11

Table 2: Distribution of Slowdown Episodes by Time Period

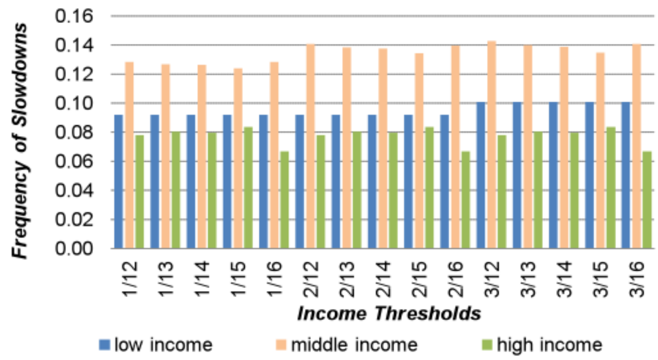
3.2 Are Middle-Income Countries at Greater Risk?

We are now able to ask: does the Middle Income Trap exist? That is, are countries that have attained middle-income status more likely to experience slowdowns than low-income and high-income countries? Because there is no commonly agreed definition of what constitutes "middle-income," we analyze this question over a range of possible lower and upper thresholds for middle income status. We start by defining sets of GDP per capita (in 2005 PPP $) thresholds. Each set i is composed of two thresholds t_i^1 and t_i^2 where $t_i^1 < t_i^2$and where t^1 is the threshold that separates low-income from middle-income and t^2 is the threshold that separates middle-income from high-income. We assume t^1 can take three values, namely 1000, 2000 and 3000 (2005 PPP $) while possible values for t^2 range from 12,000 up to 16,000 (in increments of 1000). Using this set of values generates 15 classifications (3×5) spanning a wide range of potential definitions. Figure 5 summarizes the results by plotting, within each income category, the ratio of slowdown episodes to total observations.

Figure 5 makes clear that middle-income countries are disproportionately likely to experience growth slowdowns, and this result is robust to a wide range of income thresholds for defining "middle income." In our sample, the relative frequency of slowdown episodes for the middle-income category is always significantly higher than for the other two income categories. For the remainder of this paper, when referring to income categories, we will adopt the 2/15 definition, that is, a threshold for low-income economies of 2000 constant (2005 PPP $) dollars and a threshold for high-income economies of 15,000 dollars. The main reason for this choice is that the GDP per capita classification generated by these particular cut-off points is extremely close to the GNI per capita classification employed by the World Bank.[8] Empirical results are robust to the use of neighboring thresholds instead.

[8]The most recent World Bank classification with data for 2010 is very similar to the classification yielded by our 2/15 GDP per capita rule. Actually, there is an overlap of 97 percent between the two methodologies; only eight countries are classified differently.

Figure 5. Is there a middle income trap?



[1] 1/12 refers to a low income threshold of 1000$ and a high income threshold of US$12000 in PPP terms.

[2] Frequencies are calculated as the ratio of slowdown episodes to the total number of observations per income class.

4 What Drives Sustained Growth Slowdowns?

4.1 Empirical Strategy

Having identified growth slowdowns, we now turn to studying their determinants and how they may differ between middle-income and other countries. The basic strategy is to estimate the impact of various determinants on the probability of a country experiencing a slowdown in a particular period using probit specifications. The main challenge—customary in growth empirics—is that the ex ante set of potential determinants is very large. Like growth itself, growth slowdowns could in principle be generated by a host of factors. Favorable demographics could accelerate growth (reducing the probability of a slowdown), while unfavorable demographics could depress it. Poor institutions—and there are many different types of relevant institutions—could deter innovation, hamper the efficiency of resource allocation, and reduce the returns to entrepreneurship. Structural characteristics of the economy, outward orientation, the state of infrastructure, financial depth, and labor market characteristics could exercise independent effects on growth. And macroeconomic developments, such as terms of trade movements or asset price cycles, could also change the probability of a sustained growth slowdown. Furthermore, as noted above there is virtually no theory about why and how middle-income economies may be different.

Rather than developing a restrictive theory of growth slowdowns and testing it, this paper follows a strand of recent growth literature in being agnostic about the causes of slowdowns. In what follows we consider as broad a range of factors as possible, culled from a wide reading of the empirical growth literature.[9] The set of regressors comprises 42 explanatory variables grouped into seven categories (for some justification of their presence and discussion of their expected effects based on the theoretical and empirical growth literature, as well as for details on variable units and sources, see Aiyar and others, 2013):

i) Institutions

We use five institutional variables in this category, four of which are drawn from the Economic Freedom of the World (EFW) database compiled by the Simon Fraser Institute. The Size of Government index measures the extent of government involvement in the economy, using a range of measures such as general government consumption spending, investment, subsidies and transfers as a percentage of GDP, government ownership of enterprises, and the top marginal income tax rate. The Rule of Law index combines indicators of judicial independence, contract enforcement, military interference in the rule of law, the protection of property rights, and regulatory restrictions on the sale of real property. Freedom to Trade Internationally is constructed from measures of trade taxes, nontariff trade barriers, black market exchange rates and international capital market controls. The Regulation index is an average of sub-indices measuring credit market, labor market and business regulations. The fifth variable used here is the Chinn-Ito index of financial openness (Chinn and Ito, 2006).

ii) Demography

The three variables considered are the Fertility Rate (average number of births per woman), the Dependency Ratio (ratio of children and old people to people of working age) and the Sex Ratio (ratio of men to women, interpreted as a measure of gender bias in the literature).

iii) Infrastructure

We study three kinds of infrastructure development that have been viewed as important by the literature, using data taken from Calderon and Serven (2004). Telephone Lines is the log of telephone lines per 1000 people. Power is the log of gigawatts of generating capacity per 1000 people. And Roads is the log of the length of the country's road network per square kilometer of land area.

iv) Macroeconomic environment and policies

A large variety of macroeconomic factors that have been associated with growth or shocks to growth in the literature are considered, namely Inflation, Gross Capital Inflows (as a share of GDP), Public Debt (also as a share of GDP), Trade Openness (a country's exports plus imports

[9] A few variables that have featured prominently in the growth literature, such as R&D spending, could not be included here for lack of data spanning a reasonable number of countries and decades.

divided by GDP), Terms of Trade and the occurrence of Banking Crises (a dummy variable taking value one if the country experienced a banking crisis in any of the five years preceding the current year). Four variables Oil Exporters' Price Shock, Food Exporters' Price Shock, Oil Importers' Price Shock, and Food Importers' Price Shock are also included in case the data reveals anything specific about commodity price shocks in countries that are heavily reliant on commodity exports or imports (that is, an effect above and beyond that captured by levels and differences of the country's Terms of Trade). For instance, Oil Exporter's Price Shock is defined as the change in the world oil price over the current period times the share of oil exports as percent of GDP. The other three variables are defined analogously, replacing oil by food and exports with imports when relevant.

v) Economic structure

This category features two broad types of variables: (i) GDP Share of Agriculture and GDP Share of Services (with the residual manufacturing share omitted), so as to test whether and how structural transformation of the economy may affect the likelihood of a sustained growth slowdown; (ii) Papageorgiou and Spatafora's (2012) index of (lack of) Output Diversification across (twelve) sectors, which however has to be studied separately and yields only tentative results as it is available only from 2000 onwards.

vi) Trade structure

Two dimensions are captured here, namely: (i) how unfavorable a country's geographical location is, measured by a Distance variable which for each country i sums the distance to every other country in the world j, weighting each distance by the share of country j in world GDP; (ii) Regional Integration is the amount of intra-regional trade (exports plus imports) undertaken by a country relative to its total trade; (iii) (Lack of) Export Diversification is a Theil index calculated by Papageorgiou and Spatafora (2012) using product data at the four-digit SITC level.

vii) Other

In this last module we consider variables that do not fit easily under any of the previous economic categories. ELF is an index of ethno-linguistic fractionalization, which has often been associated with poor social capital and negative growth outcomes (Easterly and Levine, 1997; and La Porta and others, 1999). Tropics measure the fraction of a country's land area that lies in the tropical zone. Various features of this climatic zone, such as poorer land productivity and conditions more favorable to vector-borne diseases could have an adverse impact on growth (Sachs and Warner, 1997; and Masters and McMillan, 2001). Being a Spanish Colony in the past and having a large Buddhist population are variables that Sala-i-Martin, Dopplehofer, and Miller (2004) find to be significantly associated with growth even after controlling for other institutional and cultural factors. Finally, Wars and Civil Conflicts, and Natural Disasters can clearly depress growth.

The actual number of right-hand-side (RHS) variables used is larger still because, as a general rule, we allow the data to speak to whether these variables influence slowdown probabilities in levels or differences. That is, the initial level (at the beginning of the period) and lagged difference of each variable both appear as regressors. Because of the focus on the determinants of sustained slowdowns, one would expect the explanatory variables to matter mostly in differences. However, in some cases the level may pick up important threshold effects, for example some institutional settings may become binding constraints and increase the likelihood of a growth slowdown once an economy has reached middle-income status.

The inclusion of a large number of potential regressors, however, has two important drawbacks: model uncertainty and data availability. The first, model uncertainty, is a standard issue in growth empirics where ignorance of the "true" model tends to inflate the number of variables on the RHS or cast doubt on those selected arbitrarily. Classical estimation methods can be of limited use in sorting out robust correlates from irrelevant variables, and growth regressions tend to generate unstable, and sometimes contradictory results (Durlauf, Kourtellos, and Tan, 2008). Our approach to address model uncertainty is to employ Bayesian model averaging techniques. More precisely, after every probit estimation (which is used to generate the main results), two Bayesian model-averaging techniques are applied to the corresponding linear probability model to assess the robustness of the results: the Weighted Average Least Squares (WALS) methodology developed by Magnus, Powell, and Prüfer (2010) and the more standard Bayesian Model Averaging (BMA) developed by Leamer (1978) and popularized by Sala-i-Martin, Doppelhoffer and Miller (2004). A technical description of the two methods is provided in Aiyar and others (2013).

The growth literature has seen increasing use of Bayesian averaging techniques, in particular the BMA.[10] But WALS is substantially faster than BMA routines. In particular, the computing time increases only linearly with the number of variables using the WALS procedure, while it increases exponentially using BMA. Given the number of regressions and variables considered in this paper, this computational advantage is not negligible. Moreover, WALS relies on a more transparent treatment of ignorance in the form of a Laplace distribution for the parameters and a different scaling parameter for the prior variance.[11] Contrasting the two methods allows us to check that our results are robust to changes in the Bayesian averaging method. As regards the growth literature, Magnus, Powell, and Prüfer (2010) have recently shown that some conclusions from Sala-i-Martin, Doppelhoffer, and Miller (2004) were not confirmed by the WALS method, implying that even slight changes to priors and distributions could lead to different diagnosis. As we shall see, it turns out that an overwhelming majority of results are confirmed by both methods. This increases our confidence in the robustness of the conclusions.

[10] See Moral-Benito (2011) for a survey.

[11] The use of a Laplace distribution rather than a normal distribution also leads to finite risk. For a detailed treatment of the conceptual differences between BMA and WALS, see Magnus, Powell, and Prüfer (2010).

The second drawback of considering many potential explanatory variables is that of data availability. Working on 138 countries over 60 years implies inevitable data gaps. In particular, even though the LHS variable consists of 1125 observations with 123 slowdown episodes, data gaps in the RHS variables can restrict drastically the actual sample used for estimation. At one extreme, if one were to use all the 42 explanatory variables in a single estimation at the same time, the actual sample size would drop to less than 170 observations (and 18 slowdowns) due to the poor overlap between the different data categories outlined above. More importantly, using only these 170 observations would imply losing almost all observations before 1995 and observations covering developing countries, thereby restricting the analysis only to recent slowdown episodes that took place in advanced economies. To address at least in part this issue, we group the potential explanatory variables into seven categories and estimate their impact on slowdowns separately.[12] With relatively large sample sizes within each grouped specification, we can then better discriminate between alternative variables falling into a given category (e.g., institutions).

Although considering all right-hand side variables in a single estimation restricts drastically the sample to about 200 observations, as an additional robustness check we perform a comprehensive Bayesian averaging exercise using all variables (with the exception of output diversification measures for lack of long time series). For (computational) simplicity, we restrict attention to the WALS framework. The results from the categorical approach that will be reported below are essentially confirmed —somewhat surprisingly so, given small sample size; in particular, virtually all the institutional, demographic, trade structure, infrastructure and macroeconomic environment variables found to be highly significant in the category-by-category approach remain significant when considered altogether.[13]

To summarize, our empirical procedure adopted proceeds through the following two steps. In step 1, for each category, we start by running probit specifications with lagged level and differenced values of all possible explanatory variables within the specific economic category. Thus, within the "institutions" category, for a slowdown episode over 1975-80, the 1975 level of each institutional variable is used together with the change in that variable between 1970 and 1975. This approach minimizes possible endogeneity issues. We use both backward and forward selection procedures to identify a restricted set of robust regressors.[14] In step 2, to assess the robustness of the preferred probit specification used in step 1, Bayesian averaging techniques (BMA and WALS) are used over the full set of variables within the economic category of interest. As a third step (unreported

[12] A similar categorization strategy is followed in Berg, Ostry and Zettlemeyer (2012)

[13] By contrast, output composition measures, as well variables reported in the "other" category, tend to lose significance. This likely reflects the impact of the exercise on sample composition. Using only 200 observations implies losing almost all observations before the 1990s as well as those covering low-income countries, thereby restricting attention to recent slowdowns in more advanced countries. This, in particular, might explain the insignificance of variables (in the "other" category) such as war, civil conflicts or natural disasters.

[14] Whenever the set of variables identified as significant differs between procedures, we consider the bigger set. In general, there happens to be excellent agreement between the forward and backward procedures.

below), we also perform a comprehensive (WALS) Bayesian averaging exercise using all variables that confirms our main results.

4.2 The key drivers of sustained growth slowdowns

As an illustration, results for the institutional variables category are reported in Table 3. The first panel presents coefficient estimates and p-values for those variables found to be significant in the "best" probit specification, that is, the probit including variables selected in Step 1 above. In this case, the forward and backward selection procedures agree exactly on the significance of three variables. The level of Rule of Law is significant at the 1 percent level: good legal systems, contract enforcement and property rights are strongly associated with a reduced probability of a growth slowdown episode. The Size of Government and Regulation indices are also highly significant but in differences: a country that reduces government involvement in the economy and deregulates its labor, product and credit markets is less likely to slow down in the subsequent period.

The second panel shows results from Bayesian model averaging for the complete set of explanatory variables, i.e. the output of Step 2 under the form of individual PIPs (for BMA) and t-ratios (for WALS). The BMA column reports posterior inclusion probabilities (PIP): the sum of the posterior probabilities of all the regressions including that variable. Computationally, it is a weighted average of the goodness-of-fit of models including a particular variable, relative to models not including that variable. Magnus, Powell, and Prüfer (2010), as well as Masanjala and Papageorgiou (2008), suggest a PIP threshold of 0.5 for inclusion of a variable whereas, in the case of WALS, a t-ratio with an absolute value of 1 or greater is typically recommended as a threshold for significance.[15] Using these criteria, both WALS and BMA find that the level of the Legal Structure and the lagged change in Size of Government and Regulation are robust correlates of growth slowdowns. In other words, both Bayesian techniques confirm the significance of variables identified using the probit analysis.

Table 4 presents a summary of all key results across all seven categories. It lists, by module, all the variables found selected as significant. Apart from showing the average marginal effect of each variable, it attempts to give a flavor of the magnitude of their impact on slowdown probabilities, as well as on possible asymmetries in this impact arising from the distributional characteristics of the variable. The last two columns of the table show the impact on the probability of a slowdown if

[15] In a nutshell, the intuitions are the following. In the BMA case, a standard procedure is to assume that every possible model has the same chance of being selected. In such case, the prior probability of including any regressor to be selected ex-ante is 0.5, and there is support for including the variable considered if the PIP rises above the prior inclusion probability after computation of the model. In the WALS case, including a particular variable implies an increase in model fit (as measure by the adjusted R2) if and only if the t ratio of the additional regressor, in absolute value, is greater than 1 (Magnus, Powell, and Prüfer, 2010).

I Final Probit Specification

Variable	Levels		Differences	
	Coef.	P>z	Coef.	P>z
Strong rule of Law	-0.089	0.005		
Small government			-0.173	0.009
Regulation			-0.210	0.003
Pseudo R2	0.07			
Obs.	599			

II Bayesian Averaging Robustness Tests

Institutions	Levels		Differences	
	WALS t	BMA PIP	WALS t	BMA PIP
Small government	0.67	0.06	**-2.43**	**0.84**
Strong rule of law	**-1.12**	**0.50**	-1.16	0.14
Freedom to trade	-0.16	0.08	-1.15	0.09
Light regulation	-0.78	0.08	**-2.34**	**0.91**
Financial openness	0.78	0.05	-0.86	0.09

Table 3: Full Results for the category *Institutions*

variable X moves from the 25th percentile of the distribution of X to the 75th percentile (integrating over all possible values for other variables in the module). The key findings are the following:

i) *Institutions.* See above.

ii) *Demographics.* A high ratio of dependants to workers, and an increase in the ratio of men to women both increase the probability of a growth slowdown in the subsequent period.

iii) *Infrastructure.* No robust results could be found, an issue we come back to below.

iv) *Macroeconomic environment and policies.* The initial level of Gross Capital Inflows / GDP is associated with a higher probability of growth slowdown. This is consistent with a "sudden stop" story, as also suggested by the result on first differences—a reduction in inflows is also associated with a higher probability of slowdown in the subsequent period. Domestic overheating also seems to matter, thus a rapid increase in an economy's Investment Share is strongly related to the slowdown probability of the subsesubsequent period. Finally, economies which increase their Trade Openness become less vulnerable to a subsequent slowdown, possibly because trade represents a diversification from purely domestic risks to a mix between domestic and external risks, thereby offering insurance against idiosyncratic domestic shocks.[16]

v) *Economic structure.* A lower initial share of value added in agriculture and services, and a shrinking share of value added in those sectors, are associated with a higher probability of a

[16]Another finding is that an increase in the Public Debt / GDP ratio is associated with a smaller slowdown probability. However, we do not report this (prima facie counterintuitive) result in Table 4 as further analysis shows that it is fully driven by a set of countries whose debts were forgiven as part of the HIPC initiative (and hence registered rapid debt reduction) but which registered poor economic performance.

growth slowdown. The most natural interpretation is that economies undergoing rapid structural change face a concomitant risk of slowdowns. During the process of economic development, surplus labor typically moves from the agricultural and (informal) services sector to formal employment in the newly expanding industrial sector. Agriculture and services shrink in relative terms, industry expands, and modern economic growth ensues. But this beneficial process creates concomitant risks of a growth slowdown.

Separately, we find support for the thesis that sectoral diversification is associated with a lower probability of growth slowdowns. This could simply reflect the relationship between diversification and growth documented by the literature, or the fact that diversification is a form of insurance against idiosyncratic shocks to a particular sector that in a concentrated economy could lead to slowdown and stagnation. vi) Trade structure. The smaller the (GDP-weighted) Distance of a country from potential trade partners, and the greater its share of intra-regional trade, the less likely is a slowdown. Proximity to world and regional economic centers may be conducive to sustained growth through expanded trade opportunities and scale economies (Redding and Venables, 2004)—as well as though better opportunities for foreign investment and knowledge spillovers. Export Diversification is not selected as significant, but a closer analysis shows that introducing Export Diversification in tandem with Distance and Regional Integration results in "throwing away" a considerable amount of data on diversification because of limited sample coverage for the other two variables. Worse, the omitted data is disproportionately from African countries, which may stand to benefit the most from diversification if the relationship between diversification and growth is non-linear. When estimating the relationship between growth slowdowns and Export Diversification separately, we find that a diversified export base is indeed associated with a lower probability of slowdown for the larger sample.

vii) *Other*. Finally, Wars and Civil Conflicts and the fraction of a country's area in the Tropics raise the probability of a growth slowdown in the next period.

Some of the variables amenable to policy are estimated to have a substantial impact on slowdown probabilities. For example, taken at face value, the results imply that improving trade integration from the 25th percentile level to the median lowers the probability of a slowdown by 2.5 percentage points, while a further move to the 75th percentile lowers that probability by a further 3.4 percentage points.

4.3 Are Middle-Income Countries Different?

Since we have already established that middle-income countries (MICs) differ from others in experiencing a higher frequency of slowdowns, it is natural to ask whether any of the determinants examined above act on MICs differently. To explore this possibility we restrict the sample to

Regressor	Probit Coeff.	WALS t-stat	BMA PiP	Average Marginal Effects	Change in slowdown probability	
					p(50)-p(25)	*p(75)-p(50)*
Institutions						
L.Rule of Law	-0.089***	-1.20	0.50	-1.7%	-3.1%	-2.6%
D.Size of Government	-0.173***	-2.43	0.84	-3.2%	-1.8%	-1.9%
D.Regulation	-0.210***	-2.34	0.91	-3.9%	-2.3%	-2.2%
Demography						
L.Dependency Ratio	0.008***	2.74	0.70	0.1%	2.7%	2.2%
D.Sex ratio	0.075***	2.29	0.78	1.4%	0.6%	0.6%
Macro Environment and Policies						
L.Gross Capital Inflows	0.028***	1.44	0.62	0.5%	1.4%	2.1%
D.Investment Share	0.059***	3.50	0.98	1.1%	3.4%	4.2%
D.Trade Openness	-0.013***	-2.09	0.51	-0.2%	-1.3%	-1.5%
D.Gross Capital Inflows	-0.016**	-1.77	0.55	-0.3%	-1.1%	-1.3%
Composition						
L.Agriculture Share	-0.012**	-1.93	0.15	-0.2%	-2.1%	-3.4%
L.Services Share	-0.015**	-1.90	0.22	-0.3%	-3.0%	-2.4%
D.Agriculture Share	-0.039**	-2.46	0.52	-0.7%	-1.6%	-0.7%
D.Services Share	-0.035**	-2.47	0.66	-0.7%	-2.0%	-1.6%
L.Output Diversification	0.034**			0.5%	2.3%	8.2%
Trade						
L.Distance	0.116***	1.77	0.35	2.4%	2.9%	1.9%
L.Regional Integration	-0.008***	-1.77	0.34	-0.2%	-2.5%	-3.4%
L.Export Diversification	0.133***			2.7%	2.5%	2.5%
Others						
Tropics	0.264**	1.70	0.36	5.0%	3.0%	1.9%
War and Civil conflicts	0.476***	2.08	0.59	9.0%		

Note: Asterisks indicate significance at the 10 percent, 5 percent and 1 percent level.

Table 4: Full results

MICs and repeat all the regressions described in the previous subsections. Table 5 shows how the results differ across the full sample and the restricted sample. A blank entry in the MIC column indicates implies that the variable is not selected as significant in the restricted sample despite being significant in the full sample. A blank entry in the full sample column implies the reverse.

Two points are worth noting with respect to institutions. First, Government Size replaces the Rule of Law as the most significant institution variable in levels. It may be that at very low levels of income, the development of a basic framework of property rights and contract enforcement has a large impact in staving off slowdowns, but once this condition is more or less satisfied the capacity of the private sector to grow and innovate becomes relatively more important. The capacity of the private sector to expand may be hampered by the extent of government involvement in the economy, which therefore shows up as significant for MICs. Related to this, the coefficient on Regulation in differences is twice as large for MICs than for the full sample of countries, suggesting again that deregulation is a particularly important channel for guarding against slowdowns in MICs. This is consistent with Aghion and others' (2005) emphasis on distance-to-frontier effects: the marginal impact of regulation is likely to be greater closer to the world technology frontier, where the key to productivity gains lies in innovation rather than absorption of existing technology.

Second, the level of infrastructure development is important in MICs, where insufficient Road Networks and Telephone Lines per head both emerge as potential risk factors for growth. In line with some of the results on institutions, infrastructure development appears to matter more once the low-income stage of development has been passed.

On trade, it should be stressed that the result that Regional Integration reduces the probability of a slowdown is obtained for MICs only after dropping outliers. That is, the reported coefficient is for a sample of MICs in which the bottom and top deciles—by degree of regional trade integration—have been excluded. Including these outliers drives the significance of the relationship below conventional limits. This suggests threshold effects: a marginal increase in regional integration has little effect if the country is initially very poorly integrated or very highly integrated.[17]

Finally, the tentative finding that both Output Diversification and Trade Diversification are negatively associated with the probability of a slowdown disappears when the sample is restricted to MICs. This is consistent with the literature emphasizing that diversification is particularly associated with economic growth in low-income countries transitioning out of a primarily agriculture-based economy, and that the relationship might even reverse beyond a certain level of income (Papageorgiou and Spatafora, 2012; Imbs and Wacziarg , 2003).

[17] It is possible that regional integration, especially the way it is measured in this study, is related to product sophistication. For example, if an economy that was initially exporting mainly resource-based commodities begins to integrate into regional vertical supply chains, that would tend to increase both regional integration as well as product sophistication. But data coverage is much better for regional integration than for product sophistication. This does not imply, of course, that the result for regional integration is spurious; merely that one of the reasons why it matters is that it spurs product sophistication.

Regressor	Coeff. Full Sample	Middle Income Coeff. Middle income	WALS	PIP
Institutions				
L. strong rule of Law	-0.089***			
L. small government		-0.150**	-2.05	0.68
D. small Government	-0.173***	-0.185*	-1.79	0.58
D. light regulation	-0.210***	-0.422***	-2.61	0.98
Demography				
L. dependency ratio	0.008***	0.011***	2.00	0.63
D. sex ratio	0.075***	0.146**	1.57	0.37
Infrastructures				
L. road network		-0.126**	-1.60	0.41
L. telephone Lines		-0.168**	-1.69	0.51
Macro Environment and Policies				
L. gross capital inflows	0.028***	0.030*	1.30	0.47
D. investment share	0.059***	0.106***	3.40	0.98
D .trade openness	-0.013***	-0.022**	-1.76	0.32
D. public debt	-0.005**	-0.013***	-2.42	0.84
D. gross capital inflows	-0.016**	-0.040***	-2.64	0.73
D. TOT		-0.008*	-1.40	0.18
Composition				
L. agriculture share	-0.012**			
L. services share	-0.015**			
D.agriculture share	-0.039**	-0.040*	-1.39	0.16
D. services share	-0.035**	-0.038**	-1.46	0.25
L. output Diversification	0.034**			
Trade				
L. distance	0.116***	0.115*	1.72	0.29
L. regional Integration	-0.008***	-0.011*	-1.22	0.11
L. weak export diversification	0.133***			
Others				
Tropics	0.264**			
War and civil conflicts	0.476***	0.544***	1.65	0.34

Note: Asterisks indicate significance at the 10 percent, 5 percent and 1 percent level.

Table 5: MICs vs Full Sample

5 Policy conclusions and implications for fast-growing Asian economies

The chief policy implications lie in the variables identified as significant in the previous section. They are hardly controversial, but they do provide intellectual ballast for supportive reforms in areas identified as important, and for a more detailed academic focus and further research in those areas.[18] Moreover, some of the identified variables are clearly more amenable to policy than others, especially over short time horizons. Prudential regulation to limit the build-up of excessive capital inflows and cushion the impact of a sudden stop, measures to enhance regional trade integration, public investment in infrastructure projects, and deregulation in areas where red tape is stifling private activity are all examples of reforms that can be enacted by incumbent governments in a relatively short period of time. At the other extreme, a country's geographical distance from potentially attractive trade partners, and its climatic conditions are essentially immune to policy. In between there are variables that could be influenced by policy but only over the medium- to long-term, such as demographic trends (e.g., through incentives to reduce fertility and combat gender discrimination) and the rule of law.

Table 6 below constructs an illustrative "growth slowdown risk" map for six Asian MICs in seven categories identified in the previous section. In each category we apply the MIC coefficients listed in Table 5 to the latest available data for the Asian MICs, to calculate the probability of an imminent slowdown over the next five years.[19] Then we look at the rankings of the six Asian MICs under each category, with one signifying the greatest risk of slowdown in that category and seven signifying the least risk. The red color indicates lower ("bad") rankings while the green color denotes higher ("good") ones, relative to other economies featured in the table.

Taken at face value, the empirical results imply that, compared with other Asian economies, Malaysia and China would face a larger risk of growth slowdown stemming from institutions. India and Indonesia are most at risk of a slowdown arising from a lack of transport and communications infrastructure. On trade, India could do more to pursue regional integration, while Thailand and the Philippines are relatively well integrated. It should be stressed that Table 6 does not rank countries according to the levels of the underlying variables, but instead according to the (weighted) mix of levels and differences that came out significant in the empirical analysis. For

[18]For example, one issue that this paper has not taken up is whether the impact of distance to frontier on economic growth – and, by extension, on the probability of a slowdown – is itself a function of time. It may be argued that technology is more easily disseminated today, with greater stocks of FDI or widespread internet connectivity, than in earlier periods of time. Another issue that might benefit from further research is the time-varying role of TFP in MICs; it is possible that once these countries have exhausted the "spurt" from the accumulation of factors of production, they must rely increasingly on productivity gains to engender further growth.

[19]We omit the category "Other" from the previous section, covering variables largely irrelevant from a policy perspective. The category "Infrastructure" is split into two columns, Communications and Road transport, because probit specifications for these variables are run separately due to their strong correlation.

Country	Institutions	Demography	Communication	Road	Output Composition	Macroeconomic Factors	Trade
China							
India							
Indonesia							
Malaysia							
Philippines							
Thailand							
Vietnam							

Table 6: A "Growth Slowdown Risk Map" for Asian Middle-Income Countries

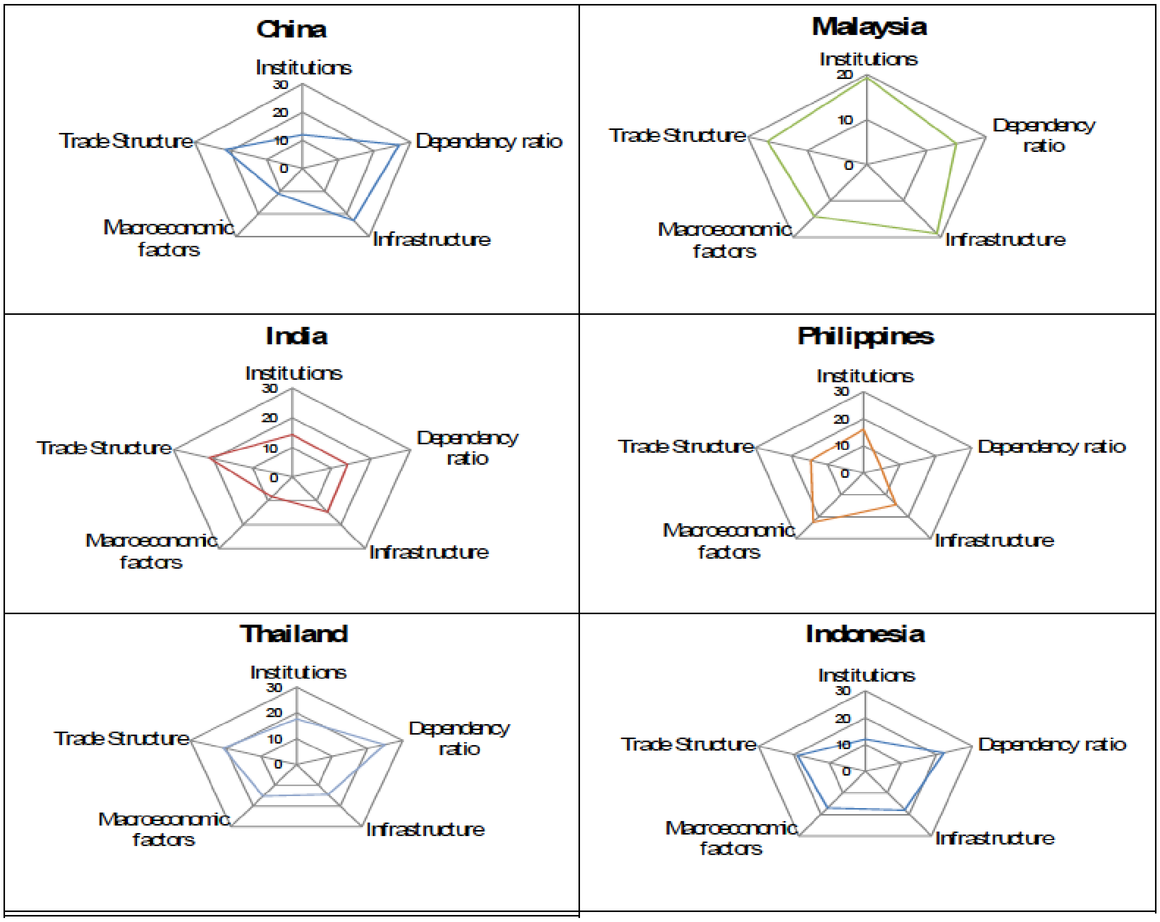
instance, the higher risk of slowdown arising from institutions in Malaysia than in China does not mean that the latter has "better" institutions than the former but rather that its institutions have improved more rapidly over the last period of the sample—since it is the difference that is found to matter for two out of the three statistically significant institutional variables in the regression analysis, see Table 4.

Finally, Figures 6 and 7 perform similar comparisons, but now focusing only on the levels of the variables. The purpose here is to identify each country's current relative strengths and weaknesses, and thereby to determine where it has most room for reducing risks of a sustained growth slowdown at some point in the future. This approach implies some departure from—although it remains qualitatively consistent with—the empirical analysis, since as noted above the latter identifies a mix of levels and differences as drivers of slowdown probabilities. For simplicity and illustrative purposes, in Figures 6 and 7 rankings in each category are computed here as simple averages of the rankings on the variables belonging to this category, and only a subset of those variables is considered. The results are shown in the form of "spider webs:" the larger the area within each country's "spider web," the better its current settings in the dimension considered.

The main findings from Figure 6 are largely consistent with those from Table 6, and Figure 7 offers some insights into how Asian economies are on average positioned relative to middle-income peers in other regions (Latin America and Middle-East North Africa). Compared with other MICs, Asia compares rather favorably on average, but there is wide cross-country heterogeneity. Several countries in the region need to develop new infrastructure and upgrade existing infrastructure in power generation, public transit systems, freight and ports. Asian MICs also show relative weaknesses on institutions, with stringent product market regulations in a number of them (e.g. India, Indonesia) remaining a risk factor. On macroeconomic factors, while Asia's growth typically benefits from its comparatively strong capital inflows and high investment rates, these also come with risks. On other dimensions, they often compare favorably to their emerging market counterparts in other regions, in particular in the trade category. Regional integration and vertical supply chains in

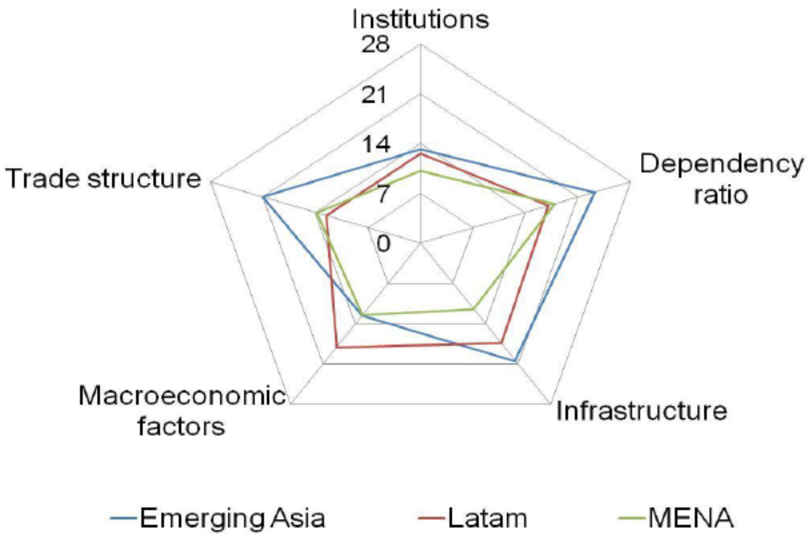
Asian MICs compare favorably with Latin American and MENA comparators. Even India and Indonesia, which lag behind the other Asian MICs in this category, are well situated compared to the broader sample. So this is an area of strength, which should serve the region well as a buffer against growth slowdowns.

Figure 6. Asian MICs' Current Strengths and Weaknesses



Note: Institutions includes small government involvement in the economy, strong rule of law and light regulation; Infrastructure includes telephone lines and road networks; Macroeconomic factors includes low gross capital inflows, low investment-to-GDP ratio, and high trade openness; Trade structure includes strong regional integration and low GDP-weighted distance. In each category, a simple average of the rankings along each individual variable is taken. We rely on latest available observations on each individual variable, with the exception of dependency ratios for which projected 2020 values (as featured in the baseline United Nations population scenario) are considered.

Figure 7: Asian MIC's Current Strengths and Weaknesses Relative to Other Emerging Regions



Note: Institutions includes small government involvement in the economy, strong rule of law and light regulation; Infrastructure includes telephone lines and road networks; Macroeconomic factors includes low gross capital inflows, low investment-to-GDP ratio, and high trade openness; Trade structure includes strong regional integration and low GDP-weighted distance. In each category, a simple average of the rankings along each individual variable is taken. We rely on latest available observations on each individual variable, with the exception of dependency ratios for which projected 2020 values (as featured in the baseline United Nations population scenario) are considered.

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Chapter 3 - Demand Recomposition and the Distribution of Income

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Abstract

This paper proposes a theory explaining the cyclical properties of the income distribution. We develop a two-sector general equilibrium model in which agents have non-homothetic preferences and differ in terms of their initial ownership of capital. We show that when sectors differ in terms of their relative labour- and capital-intensity, changes in the composition of demand are an important channel through which productivity shocks are propagated through the economy. We then use this framework to study the distributional consequences of aggregate shocks. Consistent with empirical evidence, we find income inequality (as measured by the Gini coefficient) to be counter-cyclical. This effect is driven mostly by changes in the level of employment, and to a lesser degree by changes in relative factor prices. We also find that changes in the concentration of capital ownership have negligible effects on both the level and the cyclical properties of income inequality. [JEL codes: D31, D33, E24, J31]

1 Introduction

There is a long-standing tradition in economics studying the link between inequality and macroeconomic performance. For David Ricardo, understanding how economic output is divided among the various classes of society constituted the "principal problem of Political Economy." The neoclassical representative-agent paradigm, however, has traditionally considered distributional issues to be of second-order importance. This neglect has been partly addressed by several important contributions, focusing on issues as varied as human capital accumulation Galor and Zeira (1993), industrialisation Banerjee and Newman (1993), and international trade Matsuyama (2000). That

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being said, most of this research has focused on explaining long-run trends in income inequality and their consequences for economic development. Much less is known about the cyclical properties of the income distribution.

A priori, the impact of the business cycle on inequality is unclear. While unemployment affecting low-income households should increase inequality, profits and the return to capital investment also fall during recessions. Since the owners of the capital stock tend to be located at the top of the income distribution, these forces should lead to a reduction in inequality. To date, most empirical studies relying on micro datasets have found income inequality to be countercyclical, and this effect to be mainly driven by employment and wage dynamics affecting low income households. Taken together, these studies have highlighted the importance of labour dynamics - rather than variations in capital income - in driving the income distribution in the short run. However, the underlying economic mechanisms responsible for this empirical regularity remain largely unexplored. The objective of this paper is to propose a novel theoretical framework that explains why income inequality tends to be counter-cyclical.

Motivated by a series of new stylised facts, it first emphasises the importance of changes in the composition of demand over the business cycle in understanding income dynamics. Using US industry-level data from the Bureau of Economic Analysis (BEA) over the period 1977-2010, Jin and Li (2012) find that labour-intensive sectors expand disproportionately more than capital-intensive sectors during booms. As a result, the share of production, investment and employment in capital-intensive sectors drops significantly during economic expansions, while the reverse tends to happen during recessions. Using US household consumption data also drawn from the BEA, we present new evidence showing that such pro-cyclicality of labour-intensive sectors is in part attributable to a recomposition of private demand over the business cycle, rather than to industry-specific productivity shocks. In particular, during recessions (booms), households tend to cut (increase) spending disproportionately more on labour-intensive goods and services (such as houses, motor vehicles or tourism), thereby generating high pro-cyclicality and volatility of employment and output in labour-intensive industries.

Building on this empirical evidence, we develop a model to study how such changes in the composition of demand affect the distribution of income in the short run. We design a two-sector general equilibrium model with labour market frictions in which the ownership of capital is unequally distributed among the population and consumers have non-homothetic preferences. More specifically, building on the hierarchic preferences developed by Matsuyama (2002), we assume that consumers only begin to consume secondary goods (cars) after satiating their demand for more basic goods (food). As we shall see, this implies that aggregate consumption shares vary with aggregate income, and that aggregate productivity shocks affect the allocation of capital across sectors. In addition, and consistent with empirical evidence presented below, production technologies are such that the factor share of capital is greater in sectors producing more 'basic' goods. Consequently, labour-intensive sectors are particularly sensitive to aggregate fluctuations and experience greater volatility in output and employment.

This framework allows us to answer a number of interesting questions, including: what are the distributional consequences of aggregate productivity shocks? what are the specific channels driving the cyclical properties of the income distribution? and how do changes in the wealth distribution affect the income distribution in the short-run? The theoretical results we obtain go a long way in rationalising a number of well-established and novel empirical facts. First, we find the sectoral propagation of aggregate shocks to be driven by the reallocation of capital investment across sectors. Second, the cyclical properties of the income distribution result from changes in the level of employment, and to a lesser extent from changes in relative factor prices. This is consistent with recent empirical studies which find that inequality rises during recessions because increases in unemployment and lower wages worsen the relative position of low-income groups. Finally, we find that the dynamics of the income distribution are essentially independent from the concentration of wealth, a puzzle highlighted in Castaneda et al (1998) but which had yet to receive a clear theoretical justification.

In order to gain some intuition about the underlying mechanics of the model, consider the effect of a standard productivity shock in an economic environment like the one described above. Clearly, the first *direct effect* will be a drop in aggregate output due to lower productivity. As consumers have non-homothetic preferences, this drop in income will engender a recomposition of demand away from secondary (labour-intensive) goods towards basic (capital-intensive) goods. This *demand composition effect* in turn will translate into a further fall in labour demand, over and above that generated by the aggregate productivity shock itself. In a frictional labour market, this *factor demand effect* will result in an decrease in the level of equilibrium employment and reduce wages, thereby worsening the relative position of lower quantiles. In order to study these different effects in detail, we proceed in three steps. First, we consider a Walrasian economy that abstracts from the problem of unemployment in order to analytically characterise how changes in the composition of demand affect relative factor prices and the degree of income inequality. Given the robust theoretical results we obtain from this benchmark economy, we then extend the model and explicitly incorporate labour market frictions in order to study the effects of unemployment. Lastly, we perform some simple numerical exercises which allow us to decompose the relative contribution of changing factor prices and employment rates, and study how changes in the distribution of wealth affect the cyclical movements of income inequality.

This paper builds on the theoretical literature studying how non-homothetic consumer preferences interact with income distribution effects to explain the sectoral distribution of output and employment. This literature has predominately focused on long-run macroeconomic performance;

in particular, issues related to structural change, growth and the process of industrialisation.[1] Murphy et al (1989) show how aggregate demand spill-overs and imperfectly competitive product markets can rationalise Rosenstein-Rodan's 'big-push' theory of industrialisation. In their model, the distribution of income affects the process of development via changes in the composition of demand. This idea is further developed by Matsuyama (2002), who studies how demand composition and income distribution effects interact to explain the rise of 'mass consumption' societies. As in this paper, a key assumption of Matsuyama's model is that consumer preferences are hierarchic, so that as households' income increases, they expand the range of consumer goods they purchase rather than purchasing greater quantities of the same goods. Among other things, this implies that the market size for each consumption good does not depend only on the level of aggregate income, but also on the distribution of income across households. A similar mechanism is studied by Foellmi and Zweimuller (2006).

As mentioned above, while a considerable amount of work has been done studying how the distribution of income and demand composition effects interact to explain long-run structural change, much less is known about their implications for short-run macroeconomic performance. An important exception is the recent paper by Foellmi and Zweimuller (2011), who study how inequality affects the level of aggregate employment in an economy in which consumers have non-homothetic preferences and product markets are monopolistically competitive. They consider a model with only labour as a factor of production, and focus on labour income inequality (measured in terms of heterogeneous labour endowments). Our paper, instead, considers a model with both capital and labour as factors of production, and focuses on capital income inequality (measured in terms of heterogeneous ownership shares of the capital stock). Importantly, the introduction of an additional factor of production endogenises the income distribution through changes in relative factor prices. This, in turn, allows us to explicitly address the counter-cyclical properties of the income distribution, an issue which is markedly absent from Foellmi and Zweimuller's analysis.

This paper is also naturally related to the literature studying the cyclical properties of the income distribution. Lindquist (2004) studies the role played by capital-skill complementarity in explaining the cyclical behaviour of wage inequality. His model successfully accounts for both the volatility and the cyclical behaviour of the skill premium in the United States. While we consider changes in the wage distribution to be an important component explaining the observed movements of the overall income distribution, we do not explicitly account for these changes in this paper. Contrary to this literature, the mechanism we develop does not rely on cyclical variations in the skill premium, but rather only on the *ex ante* dispersion in capital ownership. Our analysis should thus be thought as complementing the existing work done studying the cyclical properties of wage inequality. Our paper is also closely related in spirit to Castaneda et al (1998), who build

[1] See Bertola (2000) for a survey of this literature.

a model to explore to what extent unemployment spells and cyclically moving factor shares can account for the counter-cyclical properties of the Gini coefficient. Their results indicate that: (i) cyclically moving factor shares play a small role in explaining the counter-cyclicality of income inequality; and (ii) the cyclical properties of the income distribution are essentially independent from the wealth distribution. More specifically, they find that capital income fluctuations play a small role in accounting for the counter-cyclicality of the Gini coefficient. The model we develop below confirms this result, as we find that the cyclical properties of the income distribution are primarily driven by changes in wages and the level of employment, and only marginally affected by changes in the distribution of capital ownership. What is more, we clearly identify the general equilibrium effects that explain why both the level and counter-cyclicality of income inequality are largely independent of the concentration of wealth.

The rest of this paper is organised as follows. Section 2 provides a brief overview of the relevant empirical evidence motivating our theoretical framework. Section 3 describes the model. Section 4 solves for the equilibrium and examines its comparative static properties in the case where the labour market is Walrasian. Section 5 introduces labour market frictions and studies the effects of variations in the level of employment. Numerical simulations are conducted in Section 6. Concluding remarks are provided in Section 7. All proofs are relegated to the appendix.

2 Empirical Motivation

In this section, we discuss the existing empirical evidence supporting the theoretical model developed below. The key empirical claims of the model can be summarised as follows:

1. The Gini coefficient for income is counter-cyclical, increasing during recessions and diminishing during booms. This counter-cyclical property of income inequality is mainly driven by employment and wage dynamics at the bottom of the distribution.

2. The relative position of low income groups varies along the cycle because labour-intensive sectors are strongly pro-cyclical. In downturns (booms), households and firms tend to cut (increase) the share of spending dedicated to labour intensive goods and services (e.g construction, motor vehicles or tourism). Such recomposition of private demand generates high pro-cyclicality and volatility of employment and output in labour-intensive industries.

To what extent are these claims supported by empirical evidence? Below, we provide a cursory overview of existing empirical work suggesting that both claims are largely confirmed by the data. We also bring new evidence supporting the *demand composition effect* driving labour intensive sectors' volatility.

Claim 1: Counter-Cyclical Gini Coefficient Drivers The counter-cyclical properties of income inequality is now a well established empirical fact. In the case of the US, Castaneda et al (1998) document the cyclical properties of income shares decomposed by quintile for the US between 1948 and 1986 using Current Population Survey (CPS) data. The correlations, which are reported in Table 1 below, show that the income share earned by the lowest quintile is both the most volatile and the most pro-cyclical. Moreover, the pro-cyclicality of the income shares is monotonically decreasing up to the fifth percentile. Using alternative income data from the Panel Study of Income Dynamics (PSID) between 1969 to 1981, Blank (1987) also confirms that the income distribution narrows in times of economic expansion.[2] More recently, Maestri and Roventini (2012) generalise this finding by showing that almost all inequality series in OECD countries are counter-cyclical at business cycle frequencies (with the important exception of Germany).

	Correlation with Output	Volatility
1st Quintile (0-20%)	0.53	1.07
2nd Quintile (20-40%)	0.49	0.48
3rd Quintile (40-60%)	0.31	0.26
4th Quintile (60-80%)	-0.29	0.17
Next 15% (80-95%)	-0.64	0.36
Top 5% (95-100%)	0.00	0.74

Table 1: Cyclical Behaviour of Income Share by Quintile for US 1948-1986.
Source: Castaneda et al (1998)

Claim 2: Pro-Cyclical Labour-Intensive Sectors Why is income inequality pro-cyclical? Existing evidence clearly point to a strong effect of both labour and wage dynamics affecting low income households. As put by Mocan (1999), citing several previous empirical studies, "the consensus so far is that inequality rises during recessions because unemployment worsens the relative position of low-income groups." In addition to the employment effect, the heterogeneous response of labour earnings along the cycle seem to be an important source of variation: according to Blank (1989), inequality tends to narrow in expansions because the cyclicality of household head's labour market income among low-income groups is very strong. Bonhomme and Huspido (2012) recently illustrated the combined effect of earnings and employment dynamics in driving income inequality in Spain. Using information on labour earnings and employment from social security records between 1988 to 2010, the authors found that male earnings inequality was strongly countercyclical over that period, and that this evolution went in parallel with the cyclicality of employment in the lower-middle part of the wage distribution. Taken together, the existing literature therefore sug-

[2] Note that in the case of the US, Jonghyeon (2013) uses more recent CPS data and confirmed that income inequality was countercyclical in the US between 1980 to 2004.

gests that although unemployment and household earnings are pro-cyclical at each percentile of the income distribution, business cycle fluctuations are more severe at the bottom of the distribution, as documented by Heathcote et al (2010).

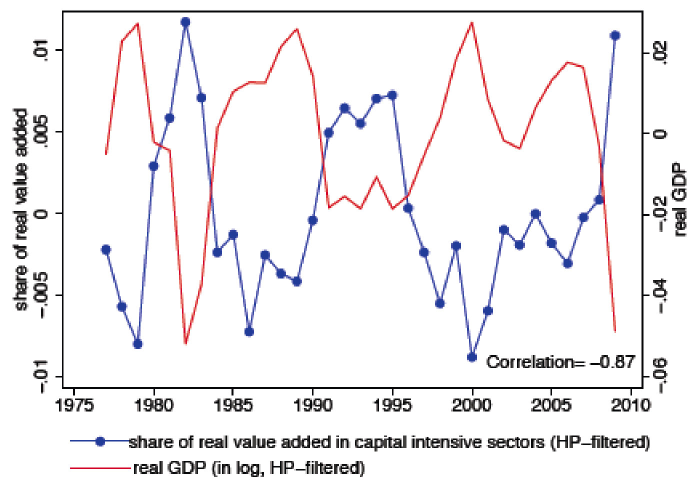

Figure 1: Correlation between the share of value added in capital-intensive sectors and GDP for US 1977-2009. *Source: Jin and Li (2012)*

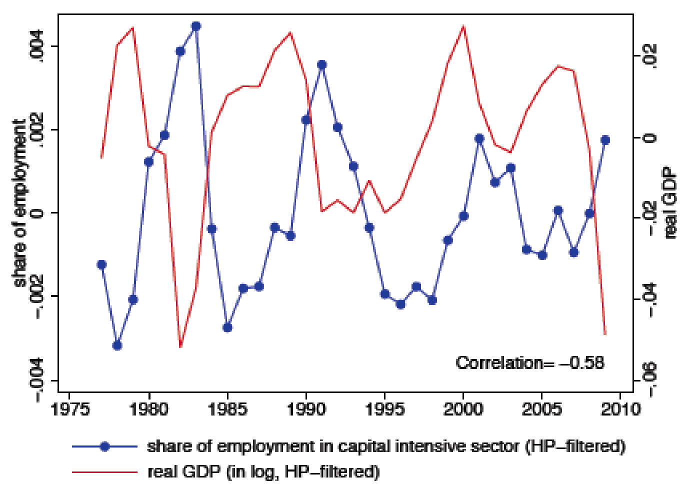

Figure 2: Correlation between the share of employment in capital-intensive sectors and GDP for US 1977-2009. *Source: Jin and Li (2012)*

Although inequality dynamics in the short run are rather well documented, the underlying mechanism is not well understood. We first argue that wage and employment dynamics in the lower part of the distribution occur because labour-intensive sectors are both more volatile and more pro-cyclical than capital intensive sectors.[3] Using US industry specific data on employment and output in several advanced economies, Jin and Li (2012) showed that labour-intensive sectors' output are significantly more volatile than that of capital-intensive sectors - more than twice as volatile in the US and on average more than 60% as volatile among 12 OECD countries.[4] Figures 1 and 2 above, taken from Jin and Li (2012), also emphasise the compositional change in US output and employment over the business cycle. Both figures clearly show the counter-cyclicality of (de-trended) output and employment shares of capital-intensive sectors. In particular, the correlation of the share of value added in capital-intensive sectors with GDP is 0.87, while the correlation of the share of employment in capital-intensive sectors with GDP is 0.58. This pattern is also found to be robust across the majority of countries in the sample, with the average corresponding correlation in a group of OECD countries being -0.53 and -0.63.

We argue that demand composition effects drive the excessive volatility of labour intensive sectors. Traditionally, heterogeneous responses to business cycle fluctuations at the sectoral level have been though to result from sector-specific productivity shocks. Instead, we argue that such sectoral dynamics reflect changes in the composition of aggregate demand, i.e. private consumption and investment. Jin and Li (2012) also measure the (de-trended) share of investment in capital-intensive sectors in total investment over the 1977 to 2009 period in the US. Their results indicate that the correlation between the share of investment in capital-intensive sectors and output is -0.70. The magnitude of this investment reallocation is also deemed to be economically significant as the share of investment in capital-intensive sectors increases by about 5% during recessions.

Examining household consumption, we also find strong evidence that the composition of aggregate consumption adjusts over the business cycle. Consumer spending in the US, as measured by the BEA Personal Consumption Expenditure (PCE), decreased in only four occasions over the last 30 years, namely during recessions in 1980, 1981/1982, 1991 and 2008/2009. Table 2 reports the respective contributions to the change in PCE during these events, using quarterly data provided by the BEA and distinguishing consumption by major type of product. Although the recessions were different in nature and magnitude, it appears that important consumption adjustments were systematically made on outlays involving high labour intensity. For instance, recessions in 1980, 1982

[3]In their study using Spanish data, Bonhomme and Huspido (2012) suggested that the counter-cyclical behaviour of inequality over the last cycle was related to changes in employment composition, in particular in favour of the (labour intensive) construction sector. We show in fact that the pro-cyclicality of labour intensive industries is a more general feature, i.e not limited to Spain over the last cycle.

[4]In the case of the US, these figures were generated with data taken from the US Bureau of Economic Analysis (BEA) Industry Economic Accounts at the NAICS 2-4 digit level from 1977 to 2009. Statistics for OECD countries are based on 2-3 digit ISIC level taken from the STAN database from 1992 to 2010. Capital shares at the industry level were constructed as follows: (capital share) = 1 - (compensation of employees)/(value-added)-(taxes less subsidies). Capital-intensive sectors are then defined as all sectors where the capital share is greater than the median.

Recession	2008		1991		1981/1982		1980	
Phase	drop	rebound	drop	rebound	drop	rebound	drop	rebound
Total PCE change (in%)	**-10,7**	**10,7**	**-4,4**	**5,4**	**-3**	**2,7**	**-9,3**	**9,8**
of which								
Durable Goods	**-4,6**	**3,7**	**-2,7**	**1,0**	**-3,7**	**1,6**	**-6,6**	**3,8**
Motor vehicles and parts	-1,8	0,7	-2,6	0,8	-2,7	2,0	-4,1	2,2
Furnishings and durable household equipment	-1,4	0,9	-0,1	0,0	-0,5	-0,3	-1,1	0,5
Recreational goods and vehicles	-1,0	1,8	0,1	0,5	-0,3	-0,1	-0,7	0,8
Other durable goods	-0,5	0,3	-0,1	-0,2	-0,2	0,0	-0,8	0,3
Non-Durable Goods	**-3,2**	**2,5**	**-1,0**	**0,8**	**0,5**	**0,3**	**-1,8**	**0,2**
Food and beverages purchased for off-premises consumptio	-1,0	0,7	-0,3	0,3	0,6	-0,1	0,2	-1,3
Clothing and footwear	-1,1	0,8	0,0	0,2	-0,1	0,3	-0,3	1,1
Gasoline and other energy goods	-0,2	0,0	-0,5	0,4	0,0	0,3	-1,4	-0,4
Other nondurable goods	-0,9	1,1	-0,2	-0,1	0,0	-0,2	-0,4	0,8
Services	**-2,9**	**4,5**	**-0,6**	**3,6**	**0,2**	**0,9**	**-1,0**	**5,8**
Housing and utilities	0,7	1,2	0,2	1,3	0,4	0,4	1,4	1,3
Health care	1,3	1,2	0,1	0,7	-0,4	-0,3	-0,2	1,8
Transportation services	-1,4	-0,1	-0,6	-0,2	-0,2	-0,2	-0,9	-0,1
Recreation services	-0,7	0,3	-0,2	0,0	0,0	0,1	0,0	0,4
Food services and accommodations	-1,3	0,5	-0,6	0,5	-0,2	0,0	-0,6	0,5
Financial services and insurance	-0,7	0,7	1,3	1,0	0,2	0,4	-0,3	1,0
Other services	-1,0	0,7	-1,3	-0,2	0,0	0,2	-0,5	0,4
Not reported (services)	0,2	0,2	0,4	0,4	0,4	0,3	0,2	0,5

Table 2: PCE change decomposition during US recessions and recoveries, 1980-2010.
Source: BEA

Note: "Drop" periods are defined as the number of quarters during which the PCE fell below zero. "Rebound" periods are defined as the (same) number of quarters following the drop period. Figures report the cumulative drop (or increase) over a given period. As an example, the PCE fell below zero over 4 quarters in 2008/2009, for a total cumulative drop of 10.7% (at annual rates). Therefore, the "rebound" column reports the cumulative increase in PCE (or sub-category) over the 4 quarters following the drop period, *i.e* from 2009 Q2 to 2010 Q2.

and 1991 were mainly characterized by adjustments in durable goods consumption, in particular in "Motor Vehicles and Parts" and to a lesser extent in "Furnishings and Durable Household Equipments." On the other hand, the 2008/2009 recession was not limited to durables and impacted both non-durables ("Clothing and Footwear") and Services ("Food services and Accommodation" and "Transportation"). Following the methodology outlined in Jin and Li (2012), we find that these goods and services all display very high labour intensity, ranging on average from 70.6% to 81.6% (see Table 3).

3 The Model

3.1 Environment

Preferences Consider an economy populated by a continuum of risk-neutral agents, indexed by $i \in [0,1]$. We denote the set of agents by $N = [0,1]$ with Lebesgue measure $\mathcal{N} = 1$. The production-side of the economy consists of two sectors, one producing basic goods (food) and the other producing secondary goods (cars). We index sectors by $s \in \{1,2\}$, and refer to sector 1 as the basic good sector and sector 2 as the secondary good sector. Consumers are assumed to have

Type of Goods/Services in PCE	Underlying Industry	Absolute Labour Intensity	Rank (among 61 sectors)
Motor Vehicles and Parts	Motor vehicles, bodies and trailers, and parts	81.6%	8th
Furnishings and Durable household equipments	Furniture and related products	74.3%	19th
Clothing and Footwear	Apparel and leather and allied products	75.3%	15th
Food Services and Accomodation	Food services and drinking places & Accommodation	70.6%	18th & 32nd
Transportation	Air Transportation & Rail Transportation	74.9%	10th & 23rd

Table 3: Labour intensity of the main underlying industry

Note: Because there is no direct equivalence between categories in the PCE and Industry-specific output tables used to compute capital/labour intensity, the "underlying industry" column reports the equivalent or closest industry among the 61 sectors listed in the NAICS 2-4 digit classification provided by the BEA.

identical non-homothetic preferences, implying that the bundle of goods they demand will depend on their income. This non-homotheticity is captured by the hierarchic structure of consumer preferences. Formally, we assume consumer preferences can be represented by the following utility function

$$u(c_1, c_2) = \begin{cases} c_1 & \text{if} \quad c_1 \leq \bar{c}_1 \\ \bar{c}_1 + c_2 & \text{if} \quad c_1 = \bar{c}_1 \end{cases}$$

where $\bar{c}_1 > 0$ denotes the satiation point for consumers' demand of the basic good. The structure of preferences implies that agents will only increase their consumption of the basic good until they reach the satiation point. After this point, agents will continue to consume a fixed amount of the basic good, and spend all additional income on the consumption of the secondary good.

Technology Production takes place using two factors of production: capital (K) and labour (L). Importantly, we assume that the two factors of production are used in different intensities in the two sectors. In line with the stylised facts presented above, we assume the secondary good sector to be relatively labour intensive, while the basic good sector to be relatively capital intensive. To simplify the analysis, we assume that production of the basic good requires only capital as an input, while the production of the secondary good combines both factors of production using a Cobb-Douglas production technology. Formally, the production technology in the basic good sector is given by

$$Y_1(K_1) = AK_1$$

while the production technology in the secondary good sector is given by

$$Y_2(K_2, L_2) = AK_2^{\alpha}L_2^{1-\alpha}$$

where $\alpha \in (0,1)$ and $A > 0$ denotes a Hicks-neutral productivity parameter[5] We assume the capital stock to be in fixed supply so that $K_1 + K_2 = \bar{K}$, where $\bar{K} > 0$ denotes the aggregate capital stock.

Endowments All agents are endowed with one unit of labour, but differ in terms of their ownership of the aggregate capital stock $\bar{K}$. Formally, we assume that each agent is characterised by a publicly observable type $\theta_i \in \Theta = [0,1]$, where $\theta_i \in [0,1]$ denotes an agent's ownership share of the capital stock such that $\int_{i\in N} \theta_i di = 1$. Ownership shares are assumed to be continuously distributed in the population according to the cumulative distribution function $G : \Theta \to [0,1]$, with associated probability density function $g : \Theta \to [0,1]$. By inverting the cumulative distribution function we obtain the quantile function $Q : \mathcal{N} \to [0,1]$ and associated quantile density function $q : \mathcal{N} \to [0,1]$, where $Q(\cdot) \equiv G^{-1}(\cdot)$ and $q(\cdot) \equiv Q'(\cdot)$. Without loss of generality, we order agents by their ownership shares such that the index of agent i also denotes the Lebesgue measure of the set $[0,i]$. This implies that we can write $\theta_i = q(i)$, where by definition we must have $\int_0^1 q(i)di = Q(1) = 1$. In order to measure the degree of wealth inequality, we define a scaling parameter $\beta > 0$ which determines the statistical dispersion of the probability distribution $G(\theta;\beta)$. As β gets large, the distribution of shares becomes increasingly unequal; as β goes to zero, the distribution of shares becomes increasingly uniform.

Assumption 1: The distribution function $G : \Theta \to [0,1]$ is such that the quantile density function is continuously differentiable and monotonically increasing such that $q'(\cdot) > 0$.

3.2 Optimality Conditions

Utility Maximisation Taking the price of the secondary good as the numeraire so that $p_2 = 1$, we can write the budget constraint of agent i as follows

$$p_1 c_{i,1} + c_{i,2} \leq I_i \equiv wl_i + \theta_i r\bar{K}, \quad \forall i \in N$$

[5]The assumption that labour does not enter the production of basic goods is without loss of generality in the sense that all results would hold even in the case of a Cobb-Douglas production function

$$Y_1(K_1, L_1) = K_1^{\phi}L_1^{1-\phi}$$

providing that $\phi > \alpha$.

where $w > 0$ and $r > 0$ denote the wage and interest rate, respectively. Note the since agents incur no disutility from labour, we will have $l_i = 1\ \forall i \in N$ in equilibrium. It follows that the aggregate labour supply will be constant an equal to $\bar{L} \equiv \int_{i \in N} l_i di = 1$. We address the issue of equilibrium unemployment in Section 5 below. The utility maximisation problem of consumers is then simply given by

$$\max_{c_{i,1},c_{i,2}} u(c_{i,1}, c_{i,2}) \quad : \quad p_1 c_{i,1} + c_{i,2} \leq w + \theta_i r \bar{K}$$

Given the hierarchic structure of consumer preferences, utility maximisation implies that agent i consumes a positive quantity of the secondary good if and only if the following condition is satisfied

$$\frac{w + \theta_i r \bar{K}}{p_1} > \bar{c}_1 \tag{1}$$

Since an agent's income is strictly increasing in the value of his ownership share θ_i, it follows that any equilibrium must have a threshold structure: i.e only agents with an ownership share greater than some (endogenous) threshold $\theta_i > \hat{\theta} \in [0, 1]$ will consume a positive quantity of the secondary good. From the above condition, we can derive an expression for the threshold ownership share as follows

$$\hat{\theta} = \frac{p_1 \bar{c}_1 - w}{r \bar{K}} \tag{2}$$

We denote by $\hat{i} \in [0, 1]$ the marginal agent such that $\theta_{\hat{i}} = \hat{\theta}$.

Profit Maximisation The objective function of a (representative) firm in sector $s \in \{1, 2\}$ is given by

$$\max_{K_s, L_s} \Pi_s = p_s Y_s(K_s, L_s) - w L_s - r K_s$$

Given the production technologies outlined above, profit maximisation in the secondary good sector implies that the equilibrium interest rate must satisfy

$$r(K_2, L_2) = \frac{\partial Y_2}{\partial K_2} = \alpha A \left(\frac{L_2}{K_2} \right)^{1-\alpha} \tag{3}$$

while the equilibrium wage rate will be such that

$$w(K_2, L_2) = \frac{\partial Y_2}{\partial L_2} = (1 - \alpha) A \left(\frac{K_2}{L_2} \right)^{\alpha} \tag{4}$$

In what follows, it will be useful to have an expression for the wage-interest rate ratio, given by

$$\rho(K_2; \alpha) \equiv \frac{w}{r} = \frac{1 - \alpha}{\alpha} K_2 \tag{5}$$

Importantly, notice that this ratio is strictly increasing in K_2. Finally, free-entry in the basic good sector pins down the price of the basic good as a function of the interest rate

$$p_1(r; A) = \frac{r}{A} \tag{6}$$

Definition 1: A Walrasian equilibrium consists of relative prices (r^*, w^*, p_1^*, p_2^*) and quantities $(c_1^*, c_2^*, K_1^*, K_2^*, L_2^*)$ such that

- All agents $i \in N$ choose consumption bundles $(c_{i,1}, c_{i,2})$ in order to maximise their utility subject to their budget constraints, taking prices as given.
- Firms in both sectors $s \in \{1, 2\}$ choose factor inputs (K_1, K_2, L_2) in order to maximise their profits, taking prices as given.
- Labour, capital and goods markets clear.

4 Equilibrium Analysis

In what follows, we restrict attention to interior equilibria such that $\hat{\theta} \in (0, 1)$. This requires us to impose some parametric restrictions so that agents are neither too rich (so that not all agents consume both goods) nor too poor (so that some agent consumes both goods). Formally, the condition guaranteeing that the equilibrium is interior is given by

$$\frac{w + \theta_0 r\bar{K}}{p_1} < \bar{c}_1 < \frac{w + \theta_1 r\bar{K}}{p_1}$$

Using the price equations (3)-(6) derived above, and recalling that $\theta_i = q(i)$, we are led to the following assumption.

Assumption 2: The distribution of ownership shares is such that

$$(1 - \alpha(1 - q(0)))A\bar{K} < \bar{c}_1 < q(1)A\bar{K}$$

Market clearing in the basic good sector implies

$$\int_0^{\hat{i}} \left(\frac{w + q(i)r\bar{K}}{p_1} \right) di + (1 - \hat{i})\bar{c}_1 = AK_1 \tag{7}$$

where $\hat{i} \in (0, 1)$ denotes the measure of constrained agents: i.e agents too poor to demand a positive quantity of the secondary good. Recall from condition (1) that constrained agents will spend all their income on the basic good, while unconstrained agents will demand a constant quantity of the basic good equal to $\bar{c}_1$. Using the free-entry condition $p_1 = r/A$ and the feasibility constraint $K_1 + K_2 = \bar{K}$, the market clearing condition simplifies to

$$A\left(\hat{\imath}\rho(K_2) + Q(\hat{\imath})\bar{K}\right) + (1-\hat{\imath})\bar{c}_1 = A(\bar{K} - K_2) \tag{8}$$

where $\rho(K_2) > 0$ denotes the wage-interest rate ratio. Finally, using the price equations (3)-(6) and the fact that $\hat{\theta} = q(\hat{\imath})$, we can rewrite the threshold condition (2) as follows

$$q(\hat{\imath}) = \frac{\bar{c}_1}{A\bar{K}} - \frac{\rho(K_2)}{\bar{K}} \tag{9}$$

These last two conditions define a system of two non-linear equations in two unknowns: the measure of constrained agents $\hat{\imath} \in (0,1)$ and the capital supplied to the secondary good sector $K_2 \in \mathbb{R}_{++}$. Its solution fully characterises the equilibrium prices and quantities for this economy.

Proposition 1: If Assumptions 1 and 2 are satisfied, there exists a unique interior Walrasian equilibrium.

Proof: See Appendix B.

4.1 Capital Reallocation Effect

Building on this existence result, we are particularly interested in understanding how equilibrium prices and quantities - especially the equilibrium allocation of capital across sectors - varies as a function of the productivity parameter A. This leads us to the following comparative static result.

Corollary 1: Following a positive/negative Hicks-neutral productivity shock, capital is reallocated from the basic/secondary good sector to the secondary/basic good sector.

Proof: See Appendix B.

What is the mechanism driving the reallocation of capital across sectors? For illustrative purposes, consider the case of a negative Hicks-neutral shock. The productivity shock obviously has as an immediate consequence a reduction of income for all agents. However, the non-homothetic preferences of consumers results in this productivity shock also engendering a recomposition of demand away from secondary goods and towards basic goods. In other words, a greater share of aggregate income is now spent on the basic good. Because of this *demand composition effect*, a greater share of capital (which is in fixed supply) is reallocated from the luxury goods sector to the basic goods sector.

Since capital and labour are complements in production of the luxury good, the reallocation of capital has as a consequence a lowering of the marginal product of labour in the luxury goods sector. As labour is inelastically supplied, this results in a lowering of the wage rate, and thereby a further decrease in the income of workers over and above the magnitude of the initial productivity shock. Below, we study these effects on factor prices in more detail.

4.2 Factor Prices

Given this capital reallocation effect following a Hicks-neutral productivity shock, we now investigate the effects on the wage and interest rate. Differentiating the wage condition (4) yields

$$\frac{dw^*}{dA} = \underbrace{(1-\alpha){K_2^*}^{\alpha}}_{\text{direct effect}} + \underbrace{\alpha(1-\alpha)A{K_2^*}^{\alpha-1}\frac{dK_2^*}{dA}}_{\text{reallocation effect}} > 0$$

The first term of this derivative corresponds to the direct effect of a productivity shock on the marginal product of labour, for a given supply of capital to the secondary good sector. The second term corresponds to the indirect effect of a productivity shock on the marginal product of labour engendered by the reallocation of capital to or from the secondary good sector (recall that capital and labour are complements in production). Turning now to the interest rate, by differentiating condition (3) we obtain

$$\frac{dr^*}{dA} = \underbrace{\alpha{K_2^*}^{\alpha-1}}_{\text{direct effect}} - \underbrace{\alpha(1-\alpha)A{K_2^*}^{\alpha-1}\frac{\frac{dK_2^*}{dA}}{K_2^*}}_{\text{scarcity effect}} \lesseqgtr 0$$

The change in the interest rate following a Hick-neutral productivity shock again consists of a direct (productivity) component and an indirect (reallocation) component. Why is the interest rate, contrary to the wage rate, not always increasing in A? The reason lies in the fact that even though capital becomes more/less productive following a positive/negative productivity shock, it also becomes relatively less/more scarce (i.e the demand for the capital-intensive good increases/decreases in relative terms). This (negative) scarcity effect counterbalances the (positive) productivity effect. It can be shown that for sufficiently small values of $\bar{K}$, the scarcity effect can in fact dominate the productivity effect, so that the interest rate will be decreasing in A. However, regardless of whether the interest rate increases or decreases, the wage-interest rate ratio will always be increasing in the productivity parameter A. This is the *factor demand effect.* Formally, we have

$$\frac{d\rho(K_2)}{dA} = \rho'(K_2)\frac{dK_2}{dA} > 0$$

where, using the factor price equations (3)-(4), we have

$$\rho'(K_2) = \frac{1-\alpha}{\alpha} > 0$$

4.3 Income Distribution

We now turn to the task of examining how the distribution of income changes following a Hicks-neutral shock to aggregate productivity. To this end, we begin by deriving the equilibrium distribution of income. Using the budget constraint of agents, it follows that individual income is given by

$$y_i \equiv I_i = w^* + \theta_i r^* \bar{K}$$

Recall that since $\theta_i \sim G(\theta)$, we must have

$$y_i \sim H(y) \equiv G\left(\frac{y - w^*}{r^* \bar{K}}\right)$$

where $y \in [y_l, y_h]$ with $y_l = w^*$ and $y_h = w^* + r^* \bar{K}$. We use the Gini coefficient to measure the degree of income inequality.

Definition 2: Given a piecewise differentiable distribution function $H(y) : [y_l, y_h] \to [0, 1]$ with associated density function $h(y) : [y_l, y_h] \to [0, 1]$, the Gini coefficient Γ is defined as

$$\Gamma = \frac{\int_{y_l}^{y_h} H(y)(1 - H(y))dy}{\int_{y_l}^{y_h} yh(y)dy}$$

Using this definition, we are lead to the following result.

Proposition 2: If Assumption 1 is satisfied, the Gini coefficient is decreasing in the productivity parameter A.

Proof: See Appendix B.

In this frictionless environment, the counter-cyclicality of the Gini coefficient is a direct consequence of changes in the wage-interest rate ratio. Note that because the Gini coefficient is scale invariant, changes in the wage and interest rate *pari passu* do not affect the degree of income inequality since scaling or multiplying all incomes by the same factor does not change the value of the Gini coefficient. However, since the wage-interest rate ratio is increasing in A, the factor by which an agent's income changes following a productivity shock is decreasing in the level of his *ex ante* wealth. This can be seen formally by noticing that the relative change in agents' income after a shock varies as a function of agents' capital ownership position

$$\frac{d\rho(K)}{dA} > 0 \quad \Rightarrow \quad \frac{d}{d\theta_i}\left(\frac{y_i + \frac{dy_i}{dA}}{y_i}\right) < 0$$

Alternatively, a simple way to interpret the cyclical dynamics of the income distribution is to notice that labour income is uniformly distributed across the population, while capital income is not. Therefore, whenever the wage increases/decreases relatively more than than the interest rate, the share of aggregate income that is uniformly distributed increases/decreases relative to the share that is unequally distributed.

5 Labour Market Frictions

As pointed out in the introduction, a large part of the variation in income inequality over the business cycle appears to be due to changes in labour income, and more specifically variation in the level of employment rate. Unfortunately, the Walrasian economy analysed above cannot account for changes in the level of employment. In particular, demand composition effects had no implications for aggregate output because factors of production were always used to full capacity. Although productivity shocks induced changes in relative prices, there was no variation along the extensive margin. To address this shortcoming, we extend the model to account for labour market frictions so that some agents remain unemployed in equilibrium. When frictions are introduced, changes in the composition of demand (insofar as they change the matching rate on the labour market) directly affect the level of employment, and thus the level of aggregate output.

5.1 Labour Market

We model frictions as in the competitive search literature pioneered by Moen (1997). In a competitive search equilibrium, firms post wage offers. Workers observe all wage offers and apply to at most one job vacancy. Firms that receive at least one application hire one worker, pay the announced wage, and produce. Workers who are not hired remain unemployed, while unfilled jobs remain vacant. In this section, we solve for the (partial) equilibrium in the labour market, treating the matching frictions as an exogenous technological constraint. Interested readers are referred to Appendix A in which the micro-foundations of the matching frictions are derived in full.

Environment Contrary to the Walrasian economy studied above, the secondary good is no longer produced by a representative firm using a Cobb-Douglas production technology. Instead, we assume the secondary good sector to consist of a continuum of homogeneous firms, each employing at most one worker. Let $F \subset \mathbb{R}_+$ denote the set of active firms in the secondary goods sector, and denote its Lebesgue measure by $\mathcal{F} \in \mathbb{R}_+$. Each firm needs at least $\kappa > 0$ units of capital to produce, which it rents on a competitive credit market at the interest rate $r > 0$. For simplicity, we normalise $\kappa = 1$. Production takes place using a constant returns-to-scale technology: i.e we assume each firm employing a worker produces $A > 0$ unit of the secondary good. Aggregate capital demanded by the secondary goods sector is thus given by

$$K_2 = \int_0^{\mathcal{F}} dj = \mathcal{F} \tag{10}$$

Matching frictions imply that not every active firm succeeds in hiring a worker, and hence not every active firm produces output in equilibrium. We assume the probability that firm j successfully hires a worker to be given by[6]

$$\mu(\mathcal{F}) = (1 - e^{-\frac{1}{\mathcal{F}}}) \tag{11}$$

Note that this probability is strictly decreasing in the measure of firms active in the secondary goods sector. Each firm posts a wage $w_j \geq 0$ in order to maximise its expected profits. Since firms are homogeneous, we will have $w_j = w$ in equilibrium. The expected profits of firms is given by

$$\mathbb{E}[\pi] = \mu(\mathcal{F})(A - w) - r \tag{12}$$

Free-entry of firms into the secondary good sector implies that expected profits must be equal to zero in equilibrium.

Partial Equilibrium We show in Appendix A that the equilibrium wage posted by firms is equal to

$$w(\mathcal{F}; A) = \frac{A}{\mathcal{F}(e^{\frac{1}{\mathcal{F}}} - 1)} \tag{13}$$

The free-entry condition pins downs the equilibrium measure of active firms as a function of the interest rate. Substituting the equilibrium wage into the objective function of firms (12) and solving for r yields an implicit condition pinning down the capital demanded by the secondary good sector. Formally, we obtain

$$A\left(1 - \left(1 + \frac{1}{\mathcal{F}(r; A)}\right) e^{-\frac{1}{\mathcal{F}(r;A)}}\right) = r \tag{14}$$

[6]See Appendix A for a detailed explanation of how this matching function is derived.

We refer interested readers to Lemma A1 in Appendix A for a formal proof of the existence and uniqueness of the partial equilibrium in the labour market. The level of employment in this economy is equal to the measure of active firms successfully hiring a worker. This is given by

$$L_2(\mathcal{F}) = \mu(\mathcal{F})\mathcal{F} \tag{15}$$

This leads us to the following result.

Lemma 1: The level of employment is strictly increasing in the quantity of capital allocated to the secondary good sector.

Proof: See Appendix B.

5.2 Equilibrium

In this section, we return to the general equilibrium model and introduce the matching frictions outlined above. Contrary to the Walrasian economy, agents now differ both in terms of their initial ownership of the aggregate capital stock and their employment status (i.e whether they are employed or unemployed). Importantly, an individual agents' employment status is independent of his capital ownership position. Given this, the market clearing condition (7) in the basic good sector becomes

$$(1 - L_2)\left(\int_0^{\hat{i}^U} \frac{q(i)r\bar{K}}{p_1} di + (1 - \hat{i}^U)\bar{c}_1\right) + L_2\left(\int_0^{\hat{i}^E} \left(\frac{w + q(i)r\bar{K}}{p_1}\right) di + (1 - \hat{i}^E)\bar{c}_1\right) = AK_1$$

where L_2 denotes the employment rate as defined by condition (15), $\hat{i}^U \in (0, 1)$ denotes the marginal unemployed agent, and $\hat{i}^E \in [0, 1)$ denotes the marginal employed agent. Note that, as before, we restrict attention to interior equilibria, implying that some (but not all) unemployed agents consume a positive quantity of the secondary good. Since unemployed agents receive no wage income, Assumption 2 simplifies to the following condition.

Assumption 3: The distribution of ownership shares is such that

$$q(0)A\bar{K} < \bar{c}_1 < q(1)A\bar{K}$$

Using the threshold condition (2), we can derive explicit expressions for the marginal unemployed and employed agent. Formally, these threshold conditions are given by

$$\hat{i}^U = q^{-1}\left(\frac{\bar{c}_1}{A\bar{K}}\right) \quad \text{and} \quad \hat{i}^E = \max\left\{0, q^{-1}\left(\frac{\bar{c}_1}{A\bar{K}} - \frac{\rho(K_2)}{\bar{K}}\right)\right\}$$

Notice that the condition pinning down the measure of constrained unemployed agents does not depend on the allocation of capital across sectors. Hence, even though the measure of unemployed agents varies as a function of the quantity of capital allocated to the secondary good sector, the quantity of basic good demanded by each unemployed agent will be constant. Intuitively, this is because unemployed agents by definition do not earn a wage, and their income is thus unaffected by changes in the wage-interest rate ratio.

Using the free-entry condition $p_1 = r/A$ and the feasibility condition $K_1 + K_2 = \bar{K}$, we can rewrite the market clearing condition as follows

$$A(\bar{K} - K_2) = (1 - L_2)\left((1 - \hat{i}^U)\bar{c}_1 + Q(\hat{i}^U)A\bar{K}\right) + L_2\left((1 - \hat{i}^E)\bar{c}_1 + Q(\hat{i}^E)A\bar{K} + \hat{i}^E A\rho(K_2)\right)$$

As before, these conditions constitute a system of two non-linear equations in two unknowns: the capital supplied to the secondary good sector $K_2 \in \mathbb{R}_{++}$ and the measure of constrained employed agents $\hat{i}^E \in (0, 1)$. This leads us to the following existence result.

Proposition 3: If Assumptions 1 and 3 are satisfied, there exists a unique interior competitive equilibrium in the model with frictions.

Proof: See Appendix B.

Given this, we now show that the capital reallocation effect remains when frictions are introduced. Moreover, from Lemma 1, this implies that the level of employment varies as a function of aggregate productivity.

Corollary 2: Following a positive/negative Hicks-neutral productivity shock, capital is reallocated from the basic/secondary good sector to the secondary/basic good sector. Moreover, the level of employment is increasing in the productivity parameter A.

Proof: See Appendix B.

Broadly speaking, this result stems from the fact that productivity shocks, insofar as they change the composition of demand due to the non-homotheticity of consumer preferences, change the measure of firms active in the secondary good sector. As total employment is proportional to the measure of active firms in the secondary good sector, productivity shocks will directly affect the level of equilibrium employment. Contrary to the Walrasian case in which productivity shocks only affected relative prices, the model with frictions is also able to capture variation along the extensive margin. This, in turn, implies that changes in the distribution of income will now be determined both by changes in the wage-interest rate ratio and by changes in the level of employment.

5.3 Income Distribution

Deriving the income distribution in the model with frictions is somewhat more involved than in the Walrasian case, since the set of agents is now partitioned into employed and unemployed workers. However, the task is simplified by the fact that an individual agent's employment status is independent of his wealth. Partitioning agents based on their employment status, we have that

$$y_i^E = w^* + \theta_i r^* \bar{K} \quad \text{and} \quad y_i^U = \theta_i r^* \bar{K}$$

where y_i^E and y_i^U denotes the income of employed and unemployed agents, respectively. Again, since $\theta_i \sim G(\theta)$ we have that

$$y_i^E \sim G\left(\frac{y^E - w}{r\bar{K}}\right) \quad \text{and} \quad y_i^U \sim G\left(\frac{y^U}{r\bar{K}}\right)$$

where $y^E \in [w^*, w^* + r^*\bar{K}]$ and $y^U \in [0, r^*\bar{K}]$. It follows that the distribution of income is given by the following piecewise continuous function

$$y_i \sim H(y) \equiv \mathbf{1}_{y \leq w} G\left(\frac{y}{r\bar{K}}\right)(1 - L_2) +$$
$$\mathbf{1}_{w<y<r\bar{K}}\left(G\left(\frac{y}{r\bar{K}}\right)(1 - L_2) + G\left(\frac{y-w}{r\bar{K}}\right)L_2\right) + \mathbf{1}_{y \geq r\bar{K}}\left((1 - L_2) + G\left(\frac{y-w}{r\bar{K}}\right)L_2\right)$$

Although well defined, deriving an analytical expression for the Gini coefficient using this income distribution function is quite tedious. Consequently, we turn to some simple numerical simulations in order to analyse how the distribution of income is affected by aggregate productivity shocks.

6 Numerical Simulations

This section is organised as follows. First, we parametrise the model with labour market frictions in order to obtain an empirically relevant value for the level of income inequality. Using this baseline parametrisation, we calculate the semi-elasticity of the Gini coefficient with respect to productivity shocks of plausible magnitudes, and analyse the extent to which variations in the level of employment on the one hand, and changes in factor prices on the other, affect income inequality over the business cycle. We then study how modifying the model's key parameters around this calibrated benchmark affect the cyclical properties of the income distribution. *Inter alia*, these comparative statics allow us to examine the consequences of variations in the distribution of wealth. Lastly, we obtain data from US over the period 1979-2005, and compare the semi-elasticity we calculate using our parametrised model with that obtained from the data.

6.1 Baseline Parametrisation

The model has four free parameters: the degree of wealth inequality β, total factor productivity A, the consumption satiation point $\bar{c}$ and the aggregate capital stock $\bar{K}$. To begin, we impose a functional form for the distribution of wealth in the economy and assume the ownership shares are Pareto distributed across the population. Formally, the cumulative distribution function of the truncated Pareto distribution over the interval $[\underline{l}, 1]$ is given by:

$$\theta_i \sim Pa(\theta; \beta, \underline{l}) = \frac{1 - \underline{l}^{\beta} \theta^{-\beta}}{1 - \underline{l}^{\beta}}$$

where $\underline{l} \in (0, 1)$ denotes the lower bound of the distribution and $\beta > 0$ is the scaling parameter. Together, these two parameters determine the degree of wealth inequality. We set these parameters such that the Gini coefficient for wealth equals 0.73, the recorded value for the US in the late 2000s (Piketty, 2013). We do this by fixing the value of β, and numerically solving for the value of the lower bound of the distribution such that the Gini coefficient for wealth takes on the desired value. The implied value is $\underline{l} = 0.001$ when $\beta = 0.01$.

Target Variable	Model	US Data	Parameter Value
Wealth Gini	0.72	0.73	$(\beta, \bar{l}) = (0.01, 0.001)$
Income Gini	0.35	0.35	$\bar{c} = 6$
Employment-to-Population Ratio	0.68	0.71	$\bar{K} = 5$
Productivity	-	-	$A = 1$

Table 4: Baseline Parametrisation.

We normalise the technology parameter $A = 1$ so that productivity shocks can be easily expressed in terms of percent deviations from the benchmark value. The consumption satiation point $\bar{c}$ and the capital stock $\bar{K}$ are then chosen in order to simultaneously match the observed degree of income inequality in the US and to obtain a plausible value for the level of equilibrium employment. We use the Gini coefficient for income before taxes and transfers reported by the BEA for the US in 2004, with a value of 0.35. The benchmark model then sets values of $\bar{c}$ and $\bar{K}$ equal to 6 and 5, respectively. This parametrisation implies an employment-to-population ratio equal to 0.68, which while below is close to the value of 0.71 for the US in 2004 reported by the OECD. The baseline parametrisation and the associated targeted values are summarised in Table 4.

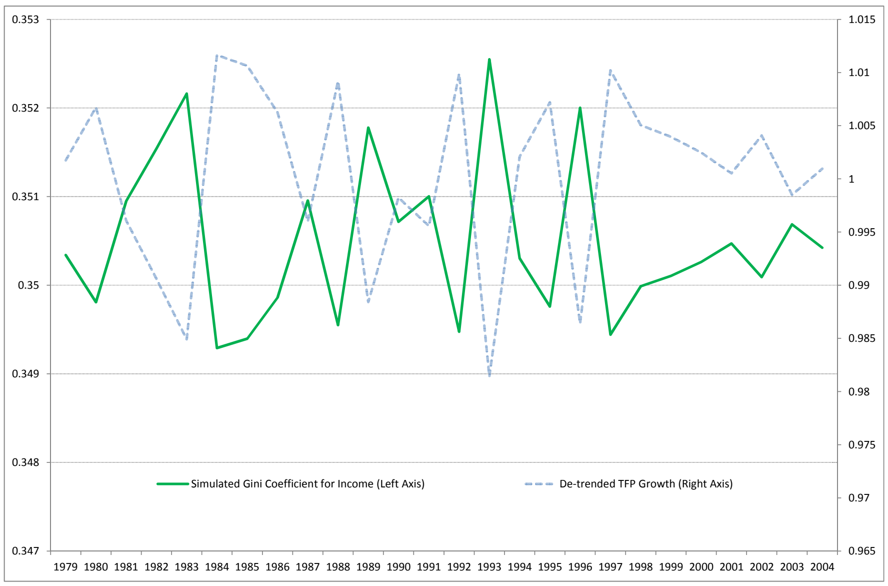

Figure 3: Simulated Gini Coefficient for Income.

6.2 Simulation and Decomposition

Using this baseline model, we simulate the cyclical behaviour of the income distribution. We do so by measuring the contemporaneous response of the simulated Gini coefficient for income to shocks to the productivity parameter A. We parametrise the magnitude of these shocks in order to match the observed pattern of de-trended total factor productivity growth in the US between 1979 and 2004, data we obtain from the San Francisco Federal Reserve. The output of this simulation exercise is represented graphically in Figure 3. As can be easily seen, the Gini coefficient for income remains counter-cyclical in the model with labour market frictions. This should not come as a surprise, given that the employment rate is itself pro-cyclical. In terms of magnitude, the model predicts that a shock that increases (decreases) TFP by 1% is associated with a rise (fall) in the Gini coefficient of 0.001 units. This elasticity is also found to be linear, with a 2% shock associated with a rise (fall) in the Gini of 0.002 units and a 5% shock associated with a rise (fall) in the Gini of 0.005 units.

Figure 4: Decomposition of Simulated Gini Coefficient.

More interestingly, we can now examine how changes in the level of employment on the one hand, and changes in factor prices on the other, contribute to the counter-cyclical movement of income inequality. We do this by calculating the Gini coefficient anew using the simulated equilibrium values, but fixing the employment rate at its benchmark value. As a result, movements in the Gini coefficient will only reflect changes in the wage-interest rate ratio. Again, we present the results graphically in Figure 4. This second simulation exercise clearly shows that variations in the level of employment is the key channel explaining the counter-cyclicality of the Gini coefficient: given the baseline parametrisation, the model suggests that only 34% of the variation in the Gini coefficient is caused by changes in relative prices, implying that the remaining 66% results from changes in the employment rate. Consistent with the empirical literature discussed above, this implies that relative price changes, in and of themselves, explain only a limited fraction of the counter-cyclical movements of income inequality.

6.3 Comparative Statics

Turning now to the comparative statics, this section examines how the simulated economy reacts to changes in the model's key parameters. In particular, we are interested in understanding how both the level of income inequality and the semi-elasticity of the Gini coefficient for income are affected by changes in the size of the aggregate capital stock, the consumption satiation point, and the degree of wealth inequality.

$\bar{K}$	Gini Coefficient ($\bar{c} = 6$)	L^*	$\bar{c}$	Gini Coefficient ($\bar{K} = 5$)	L^*
5.0	0.35	0.68	6	0.35	0.68
4.5	0.37	0.65	8	0.39	0.64
4.0	0.40	0.61	10	0.42	0.61
3.5	0.43	0.57	12	0.46	0.57
3.0	0.47	0.52	14	0.50	0.53

Table 5: Income Inequality: Comparative statics for ($\bar{K}$,$\bar{c}$) around benchmark parametrisation.

Changes to the aggregate capital stock $\bar{K}$ and the consumption satiation point $\bar{c}$ have opposite, but otherwise similar effects on both the level of income inequality and its cyclical properties. For example, a lower aggregate capital stock for a given satiation point, or a higher satiation point for a given size of the capital stock, leads to higher level of income inequality. This is because such changes lead to a sizeable decrease in the employment rate as less capital is supplied to the labour-intensive sector. Table 5 summarises the degree of income inequality for different values of the two parameters, and the associated equilibrium employment rate. We also find that at higher levels of income inequality, the Gini coefficient for income is more sensitive to productivity shocks. Again, this is because for a productivity shock of a given magnitude, the degree of capital reallocation across sectors will be increasing in the level of inequality. Table 6 reports the calculated semi-elasticity of the Gini coefficient for the same values of $\bar{K}$ and $\bar{c}$ as above.

$\bar{K}$	Semi-Elasticity ($\bar{c} = 6$)	$\bar{c}$	Semi-Elasticity ($\bar{K} = 5$)
5.0	0.0011	6	0.0010
4.5	0.0011	8	0.0014
4.0	0.0013	10	0.0018
3.5	0.0015	12	0.0023
3.0	0.0018	14	0.0029

Table 6: Semi-Elasticity: Comparative statics for ($\bar{K}$,$\bar{c}$) around benchmark parametrisation

The above results show, quite intuitively, that the degree to which income inequality reacts to business cycle shocks will be greater in economies with a lower rate of employment. More generally, they indicate that the magnitude of the cyclical movements of the income distribution are essentially determined by the level of income inequality, insofar as it determines the degree of demand recomposition over the business cycle. But how is the level of income inequality and its cyclical properties affected by the concentration of wealth? To answer this question, we examine the effect of changes in the value of $\underline{l}$, the parameter that measures the lower bound on the distribution of capital ownership. The results reported Table 7 clearly indicate that both the degree of income inequality and its cyclicality are largely unaffected by changes in the distribution of capital ownership. Interestingly, this mirrors closely the results of Castaneda et al (1998), who also find that the cyclical properties of the income distribution are essentially independent of the wealth distribution. It also supports the claim that the brunt of the movement in income inequality over the business cycle is caused by changes in the employment rate, and to a lesser degree changes in relative prices, and that changes in the degree of wealth inequality in and of themselves have very little effect.

$\underline{l}$	Gini Income	Semi-Elasticity	Gini Wealth
0.001	0.35	0.0011	0.72
0.005	0.36	0.0013	0.62
0.010	0.36	0.0014	0.58
0.015	0.36	0.0014	0.55
0.20	0.36	0.0014	0.53

Table 7: Semi-Elasticity: Comparative statics for $\underline{l}$ around benchmark parametrisation.

In addition to having no sizeable effect on the cyclical properties of the income distribution, the *level* of income inequality also appears to be largely independent of the concentration of wealth. Standard general equilibrium effects are the cause of this seemingly paradoxical result. As an illustration, consider what would happen following an exogenous redistributive shock that leads to a reduction in the degree of wealth inequality. As the revenue accruing to owners of the capital stock will now be more equitably distributed, the direct effect of this redistribution will be a reduction in inequality. However, the implied income effects will also engender a recomposition of aggregate demand away from secondary (labour-intensive) goods towards basic (capital-intensive) goods. This translates into a greater share of aggregate income accruing to capital as it becomes the relatively more scare factor of production. In equilibrium, these two effects almost perfectly cancel each other out: the decrease in inequality caused by the initial redistribution is neutralised by a fall in the wage-interest rate ratio and employment rate, which itself leads to an increase in the returns to capital compared to labour.

6.4 Empirical *versus* Simulated Semi-Elasticities

We conclude this section by comparing the simulated semi-elasticity we obtain using our baseline parametrisation with the empirical semi-elasticity calculated using US data from 1979 to 1999.

To do so, we gathered annual data on the Gini coefficient for income before taxes and transfers from the BEA. De-trending this series, we isolated the cyclical component of income inequality as measured by the Gini coefficient. We then calculated the simulated cyclical component of the Gini coefficient using the same data on de-trended total factor productivity growth described above. Figure 5 plots these two series and calculates their correlation.

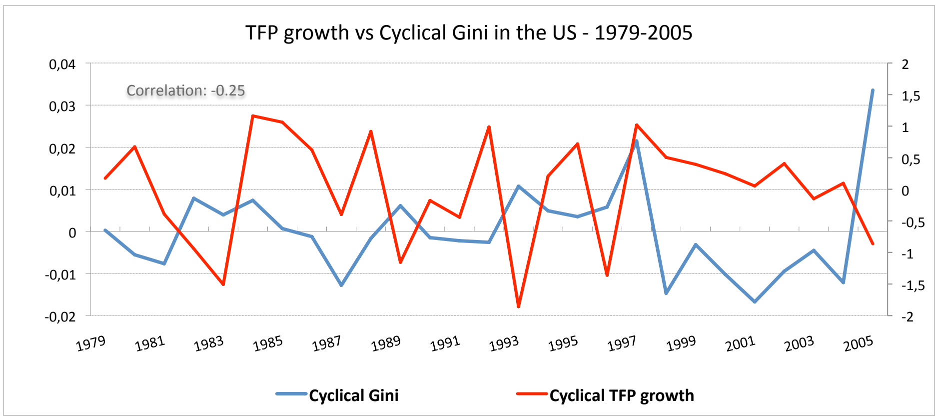

Figure 5: Cyclical Component of Gini Coefficient and De-trended TFP Growth, US 1979-2005.
Source: BEA and San Francisco Federal Reserve

In order to obtain an estimate for the semi-elasticity of the Gini coefficient for income, we simply regress the cyclical component of the Gini coefficient on de-trended total factor productivity growth. We adopt two specifications, one in which we use the contemporaneous value of TFP growth and one in which TFP growth enters the regression with a one year lag. Since the data is de-trended, we do not include a coefficient in the regression model. The results of these two regressions are reported in Table 8 below.

Variable	**Coefficient**	**Coefficient**
	(Std. Err)	(Std. Err.)
TFP_t	-0.0031	-
	(0.0023)	
TFP_{t-1}	-	$\mathbf{-0.0038}^*$
		(0.0019)

Table 8: Estimated Semi-Elasticity of Gini Coefficient for Income, US 1979-2005.

As can be seen from the table, the estimated semi-elasticity of the Gini coefficient lies in the range -0.003 to -0.004. While we do not wish to place excessive weight on the precision of these estimates, we do believe they give us a good indication of order of magnitude. Using the baseline parametrisation, the simulated model thus seems to explain 25-30% of the change in income inequality. If we deviate from the baseline parametrisation and increase the value of the consumption satiation point, then the simulated model can capture up to 75% of the estimated effect. However, as mentioned above, such a specification implies unrealistically low levels of income inequality and employment. Several omissions from the model, that we leave for further research at this stage, can explain this discrepancy. One of the most glaring and obvious is the model's failure to account for movements in the wage distribution among employed workers. In our framework, employment probabilities and wages do not depend on the position of the agent in the distribution. Still, several empirical studies have shown that although unemployment and household earnings are pro-cyclical along the whole income distribution, business cycle fluctuations are more severe at the bottom of the distribution. Extending the model along these lines seems necessary in order to better capture the magnitude of changes in income inequality over the business cycle.

7 Conclusion

This paper proposes a new theory explaining the counter-cyclical property of the income distribution. After motivating empirically the extent of demand recomposition over the business cycle, we developed a model to study how such demand composition effects affect the distribution of income in the short run. To this end, we designed a two-sector general equilibrium model with labour market frictions in which (i) the ownership of capital is unequally distributed among the population, (ii) consumers have non-homothetic preferences and (iii) sectors differ in terms of their relative labour- and capital-intensity. Using this framework, we first show that changes in the composition of demand are an important channel through which productivity shocks are propagated through the economy. Second, and more importantly, we cast a new light on the specific channels driving short-run changes in the distribution of income. Income inequality (as measured by the Gini coefficient) is found to be counter-cyclical, and this effect is driven by changes in the level of employment, and to a lesser degree by changes in relative factor prices. Interestingly, these theoretical results go a long way in rationalising the results of recent empirical studies which found that inequality rises during recessions because increases in unemployment and lower wages worsen the relative position of low-income groups. Finally, we find that the dynamics of the income distribution are essentially independent from the concentration of wealth, a puzzle highlighted in Castaneda et al (1998) but which had yet to receive a clear theoretical justification

More generally, we believe this paper calls for additional research on the short-run consequences of changes in the composition of aggregate demand. To date, most studies have examined variations in spending over the business cycle using characteristics of the products, such as their tradability or durability. However, as stated above, sorting goods and services by factor-intensity of inputs (rather than end-use) suggests that there are significant differences in the way sectors respond to business cycle shocks, with important consequences for factor prices and income dispersion. *Inter alia*, explicitly modelling such demand composition effects might help in addressing some of the shortcomings of heterogeneous agent models. As pointed out by Oh (2013), standard business cycle models with only shocks to total factor productivity (TFP) fail to explain the cyclicality of inequality, which in turn precludes a careful examination of the welfare costs of business cycles. Introducing and exploring in more detail the consequences of these largely-ignored aspects of economic fluctuations constitutes an important avenue for further research.

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8 Appendix A: Competitive Search Equilibrium

This section provides formal derivations of the partial equilibrium in the labour market.

Environment Firms post wage announcements $w_j \geq 0$. After having observed the distribution of wage announcements, each worker chooses a (symmetric) application strategy, denoted by $\sigma_j \in [0,1]$ for all $j \in F$ such that $\int_0^{\mathcal{F}} \sigma_j dj = 1$. The workers' application strategies induce an expected queue length at each firm, denoted by $\lambda_j \geq 0$. This corresponds to the expected number of job applicants at a firm posting wage w_j. Given the assumption that application strategies are symmetric and independent across workers, the actual number of applicants at a firm posting wage w_j is a Poisson random variable with mean λ_j. Each firm posting wage w_j receives $z \in \{0, 1, 2, ...\}$ applicants with probability $\frac{\lambda_j^z e^{-\lambda_j}}{z!}$. It follows that the probability that a worker applying to a firm posting a wage w_j is hired is equal to

$$\nu(\lambda_j) = \lim_{\bar{z} \to \infty} \sum_{z=0}^{\bar{z}} \frac{1}{(z+1)} \frac{\lambda_j^z e^{-\lambda_j}}{z!} = \frac{1 - e^{-\lambda_j}}{\lambda_j}$$

It follows that we must have

$$\mu(\lambda_j) \equiv \lambda_j v(\lambda_j) = (1 - e^{-\lambda_j})$$

The queue lengths are determined such that each worker obtains an expected utility of at least $V > 0$ from applying to any active firm. Since a worker facing a queue of length λ_j is hired with probability $\nu(\lambda_j)$, this implies the following indifference condition must hold in equilibrium

$$\nu(\lambda_j) w_j = V$$

Labour market clearing requires that the total number of workers searching for a job must equal the aggregate labour supply. Formally, this implies

$$\int_0^{\mathcal{F}} \lambda_j dj = 1$$

Definition A1: A competitive search equilibrium is defined as a tuple $\langle w, \lambda, V, \mathcal{F} \rangle$ such that

- Firms choose wages w to maximize expected profits, taking as given workers' expected utility V and queue lengths λ.
- Each worker applies to exactly one firm thereby inducing queue lengths λ, taking the profile of wages w as given.

- Queue lengths λ and the measure of firms entering the market $\mathcal{F}$ are such that the labour market clears.

Equilibrium We now solve for the partial equilibrium in the labour market, taking the interest rate $r > 0$ as exogenous. Begin by substituting the indifference condition into the objective function of firms as given by condition (12)

$$\mathbb{E}[\pi_j] = A(1 - e^{-\lambda_j}) - \lambda_j V - r$$

Differentiating this equation with respect to λ_j yields the first-order condition

$$\lambda_j = \log\left(\frac{A}{V}\right), \quad \forall j \in \mathcal{F}$$

Since the RHS of this condition does not depend on j, it must be that the equilibrium queue lengths (and thus the equilibrium wage announcements) are the same for all active firms. Given this, the labour market clearing condition implies

$$\lambda(\mathcal{F}) = \frac{1}{\mathcal{F}}$$

Combining the last two equations allows us to solve for the equilibrium expected utility of workers

$$V(\mathcal{F}; A) = Ae^{-\frac{1}{\mathcal{F}}}$$

Plugging this condition into the indifference condition of workers, we can solve for the wage posted by firms in equilibrium

$$w(\mathcal{F}; A) = \frac{A}{\mathcal{F}(e^{\frac{1}{\mathcal{F}}} - 1)}$$

Substituting this into the expected profit condition (12) and simplifying, we obtain

$$\mathbb{E}[\pi] = A\left(1 - \left(1 + \frac{1}{\mathcal{F}}\right)e^{-\frac{1}{\mathcal{F}}}\right) - r$$

Free-entry of firms into the secondary good sector implies expected profits are equal to zero in equilibrium. This pins down the equilibrium measure of active firms as a function of the interest rate. Setting the last condition equal to zero and solving for r yields

$$r = A\left(1 - \left(1 + \frac{1}{\mathcal{F}(r; A)}\right)e^{-\frac{1}{\mathcal{F}(r;A)}}\right)$$

This leads us to the following existence result.

Lemma A1: Given any interest rate $r \in (0, A]$, there exists a unique competitive search equilibrium. Moreover, the equilibrium measure of active firms $\mathcal{F}^*$ is decreasing in r and increasing in A.

Proof: Begin by noticing that expected gross revenue of a firm is a continuous and monotonically decreasing function of the measure of active firms, beginning at A when $\mathcal{F} = 0$ and converging to 0 as $\mathcal{F} \to \infty$. Formally,

$$\frac{d}{d\mathcal{F}}\left(A\left(1-\left(1+\frac{1}{\mathcal{F}}\right)e^{-\frac{1}{\mathcal{F}}}\right)\right) = -\frac{e^{-\frac{1}{\mathcal{F}}}}{\mathcal{F}^3} < 0$$

It follows that given any (exogenous) interest rate $r \in (0, A]$, there exists a unique and finite equilibrium measure of active firms $\mathcal{F}^*(r; A)$. $\square$

9 Appendix B: Proofs

9.1 Proof of Proposition 1.

Recall that the LHS of condition (8) corresponds to the aggregate demand for the basic good, while the RHS equals the aggregate supply of the basic good. It is easy to verify that the RHS is monotonically decreasing in K_2 from $[A\bar{K}, 0]$ on the interval $K_2 \in [0, \bar{K}]$. Differentiating the LHS with respect to K_2, we obtain

$$\frac{d\hat{i}}{dK_2} \underbrace{\left(A\left(\rho(K_2) + q(\hat{i})\bar{K}\right) - \bar{c}_1\right)}_{=0} + A\left(\frac{1-\alpha}{\alpha}\right)\hat{i} > 0$$

where the inequality follows from Assumption 2, since it implies that $\hat{i} \in (0, 1)$ is such that

$$\frac{w + q(\hat{i})r\bar{K}}{p_1} = \bar{c}_1$$

It follows that aggregate demand for the basic good is monotonically increasing in K_2. Evaluating the LHS of the market clearing condition (8) at $K_2 = 0$, we have that

$$Q(\hat{i})A\bar{K} + (1 - \hat{i})\bar{c}_1 < A\bar{K}$$

since $\rho(0) = 0$. Rearranging, we obtain

$$(1 - Q(\hat{i}))A\bar{K} > (1 - \hat{i})\bar{c}_1$$

where the inequality follows from Assumption 1 since $Q(i) < i$ for all $i \in (0, 1)$, and Assumption 2 since $A\bar{K} > \bar{c}_1$. It follows that there exists a unique equilibrium. □

9.2 Proof of Corollary 1.

Rewriting the market clearing condition (8) and differentiating with respect to A yields

$$\frac{dK_2^*}{dA} = (1 - \hat{i}^*)\frac{\bar{c}_1}{A^2} - \hat{i}^*\rho'(K_2^*)\frac{dK_2^*}{dA} + \frac{d\hat{i}^*}{dA}\underbrace{\left(\frac{\bar{c}_1}{A} - \rho(K_2^*) - q(\hat{i}^*)\bar{K}\right)}_{=0}$$

Solving for dK_2^*/dA, we obtain

$$\frac{dK_2^*}{dA} = \omega(\hat{i}^*; \alpha)\frac{\bar{c}_1}{A^2} > 0$$

where

$$\omega(\hat{i}; \alpha) = \frac{\alpha(1-\hat{i})}{\alpha + (1-\alpha)\hat{i}} \in (0, 1)$$

This completes the proof. □

9.3 Proof of Proposition 2.

We begin by rewriting the Gini coefficient in terms of the quantile function. Formally,

$$\Gamma = 1 - 2\int_0^1 L(x)dx$$

where

$$L(x) = \frac{\int_0^x H^{-1}(p)dp}{\int_0^1 H^{-1}(p)dp}$$

is the Lorenz curve and $H^{-1}(p) = w^* + Q(p)r^*\bar{K}$ is the income quantile function. It follows that the Gini coefficient will be decreasing in A if and only if the Lorenz curve is increasing in A. Formally,

$$\frac{d}{dA}\frac{\int_0^x w^* + Q(p)r^*\bar{K}dp}{\int_0^1 w^* + Q(p)r^*\bar{K}dp} > 0$$

Multiplying and dividing by r, we have

$$\frac{d}{dA}\frac{\int_0^x \rho^*(A) + Q(p)\bar{K}dp}{\int_0^1 \rho^*(A) + Q(p)\bar{K}dp} > 0$$

which implies

$$\left(\int_0^x \frac{d}{dA}\rho^*(A)dp\right)\int_0^1 H^{-1}(p)dp - \left(\int_0^1 \frac{d}{dA}\rho^*(A)dp\right)\int_0^x H^{-1}(p)dp > 0$$

Simplifying, we obtain

$$\left(x\int_0^1 H^{-1}(p)dp - \int_0^x H^{-1}(p)dp\right)\frac{d}{dA}\rho^*(A) > 0$$

From Assumption 1, we must have

$$x > L(x) = \frac{\int_0^x H^{-1}(p)dp}{\int_0^1 H^{-1}(p)dp}$$

Since $\rho^*(A)$ is always increasing in A, this completes the proof. □

9.4 Proof of Lemma 1.

The result is obtained by differentiating the employment condition (15) with respect to the measure of active firms $\mathcal{F}$. It is easy to verify that $\frac{dL_2}{d\mathcal{F}} > 0$. Since the capital demand condition (10) implies that $K_2 = \mathcal{F}$, the result follows immediately. □

9.5 Proof of Proposition 3.

Differentiating the RHS of the marketed clearing condition with respect to K_2 yields

$$\underbrace{\frac{dL_2}{dK_2}}_{(+)}\left(D_1^E(K_2) - \bar{D}_1^U\right) + L_2\left(\underbrace{\frac{d\hat{i}^E}{dK_2}\left(A\rho(K_2) + q(\hat{i}^E)A\bar{K} - \bar{c}_1\right)}_{=0} + \hat{i}^E A \underbrace{\rho'(K_2)}_{(+)}\right)$$

where $D_1^E(K_2)$ and $\bar{D}_1^U$ denotes the quantity of basic good demanded by employed and unemployed agents, respectively. Notice that, contrary to the Walrasian case, all employed agents can be unconstrained in equilibrium. That is, we can have

$$\frac{w + q(\hat{i}^E)r\bar{K}}{p_1} > \bar{c}_1$$

implying that $\hat{i}^E = 0$. Notice that by definition in such a case we will have $d\hat{i}^E/dK_2 = 0$. Using the capital demand, wage and free-entry conditions (10), (13)-(14) we have

$$\rho'(K_2) = \rho(K_2)^2\left(2 - \left(1 - \frac{1}{K_2}\right)e^{\frac{1}{K_2}} - \left(1 + \frac{1}{K_2} + \frac{1}{{K_2}^2}\right)e^{-\frac{1}{K_2}}\right) > 0$$

It follows that the aggregate demand of basic good will be monotonically increasing in $\mathcal{F}$ if and only if employed agents demand strictly more basic good than unemployed agents. Formally,

$$D_1^E(K_2) - \bar{D}_1^U = (\hat{i}^U - \hat{i}^E)\bar{c}_1 + \hat{i}^E A\rho(K_2) - Q(\hat{i}^U - \hat{i}^E)A\bar{K} > 0$$

Dividing by $A\bar{K}$ and noticing that $q(\hat{i}^U) = \bar{c}_1/A\bar{K}$, we obtain

$$(\hat{i}^U - \hat{i}^E)q(\hat{i}^U) + \hat{i}^E \frac{\rho(K_2)}{\bar{K}} - Q(\hat{i}^U - \hat{i}^E) > 0$$

where the inequality follows from Assumption 1 as long as $\hat{i}^U \neq \hat{i}^E$. From Assumption 3, we have that $\hat{i}^U > \hat{i}^E$ since $\hat{i}^U > 0$ and $\hat{i}^E < 1$. Evaluating aggregate demand for the basic good at $K_2 = 0$, and noticing that $L_2 = 0$ when $K_2 = 0$, we must have

$$Q(\hat{i}^U)A\bar{K} + (1 - \hat{i}^U)\bar{c}_1 < A\bar{K}$$

Rearranging, we obtain

$$(1 - Q(\hat{i}^U))A\bar{K} > (1 - \hat{i}^U)\bar{c}_1$$

which is always the case as long as $\hat{i}^U < 1$ since $Q(\hat{i}^U) < \hat{i}^U$ and $A\bar{K} > \bar{c}_1$ by assumption. Finally, since aggregate supply of the basic good is monotonically decreasing in K_2 starting at $A\bar{K}$ when $K_2 = 0$, it follows that there exists a unique competitive equilibrium. □

9.6 Proof of Corollary 2.

Rearranging the market clearing condition, we obtain

$$K_2^* = \bar{K} - (1 - L_2)\left((1 - \hat{i}^U)\frac{\bar{c}_1}{A} + Q(\hat{i}^U)\bar{K}\right) - L_2\left((1 - \hat{i}^{E*})\frac{\bar{c}_1}{A} + Q(\hat{i}^{E*})\bar{K} + \hat{i}^{E*}\rho(K_2^*)\right)$$

Differentiating this condition with respect to A yields

$$\frac{dK_2^*}{dA} = \frac{(1 - L_2)(1 - \hat{i}^U)\bar{c}_1 + L_2(1 - \hat{i}^{E*})\bar{c}_1}{A^2} -$$
$$(D_1^E(K_2^*) - \bar{D}_2^U)\frac{\partial L_2}{\partial K_2}\frac{dK_2^*}{dA} - L_2\left(\hat{i}^{E*}\rho'(K_2^*)\frac{dK_2^*}{dA} + \underbrace{\frac{d\hat{i}^{E*}}{dA}\left(\rho(K_2^*) + q(\hat{i}^{E*})\bar{K} - \frac{\bar{c}_1}{A}\right)}_{=0}\right)$$

where again we have that whenever $\hat{i}^E = 0$ we will have $d\hat{i}^E/dA = 0$. Rearranging yields the following comparative static condition

$$\frac{dK_2^*}{dA} = \frac{(1 - L_2)(1 - \hat{i}^U)\bar{c}_1 + L_2(1 - \hat{i}^{E*})\bar{c}_1}{A^2}\left(1 + \hat{i}^{E*}\rho'(K_2^*)L_2 + (D_1^E(K_2^*) - D_2^U)\frac{dL_2}{dK_2}\right)^{-1} > 0$$

This completes the proof. □

10 Appendix C: Tables and Figures

Rank	Industry Title	Labor Share	Capital Share
1	Educational services	91,8%	8,2%
2	Hospitals and nursing and residential care facilities	91,5%	8,5%
3	Securities, commodity contracts, and investments	90,7%	9,3%
4	Computer systems design and related services	90,4%	9,6%
5	Management of companies and enterprises	90,0%	10,0%
6	Printing and related support activities	87,6%	12,4%
7	Social assistance	82,4%	17,6%
8	Motor vehicles, bodies and trailers, and parts	81,6%	18,4%
9	Warehousing and storage	80,2%	19,8%
10	Air transportation	79,0%	21,0%
11	Other transportation equipment	78,0%	22,0%
12	Computer and electronic products	76,9%	23,1%
13	Administrative and support services	76,3%	23,7%
14	Wood products	75,7%	24,3%
15	Apparel and leather and allied products	75,3%	24,7%
16	Ambulatory health care services	75,3%	24,7%
17	Textile mills and textile product mills	75,0%	25,0%
18	Food services and drinking places	74,6%	25,4%
19	Furniture and related products	74,3%	25,7%
20	Retail trade	72,4%	27,6%
21	Primary metals	72,3%	27,7%
22	Machinery	71,7%	28,3%
23	Rail transportation	70,7%	29,3%
24	Other transportation and support activities	70,6%	29,4%
25	Fabricated metal products	70,1%	29,9%
26	Wholesale trade	69,0%	31,0%
27	Support activities for mining	68,8%	31,2%
28	Construction	67,7%	32,3%
29	Amusements, gambling, and recreation industries	67,7%	32,3%
30	Information and data processing services	67,3%	32,7%
31	Other services, except government	66,8%	33,2%
32	Accommodation	66,6%	33,4%
33	Nonmetallic mineral products	66,5%	33,5%
34	Truck transportation	64,3%	35,7%
35	Plastics and rubber products	64,1%	35,9%
36	Electrical equipment, appliances, and components	63,7%	36,3%
37	Miscellaneous professional, scientific, and technical services	63,3%	36,7%
38	Transit and ground passenger transportation	62,7%	37,3%
39	Miscellaneous manufacturing	61,7%	38,3%
40	Publishing industries (includes software)	61,2%	38,8%
41	Insurance carriers and related activities	60,2%	39,8%
42	Waste management and remediation services	59,9%	40,1%
43	Paper products	58,3%	41,7%
44	Legal services	57,4%	42,6%
45	Performing arts, spectator sports, museums, and related activities	56,5%	43,5%
46	Funds, trusts, and other financial vehicles	55,7%	44,3%
47	Mining, except oil and gas	53,0%	47,0%
48	Water transportation	52,6%	47,4%
49	Food and beverage and tobacco products	51,8%	48,2%
50	Motion picture and sound recording industries	51,8%	48,2%
51	Forestry, fishing, and related activities	50,4%	49,6%
52	Pipeline transportation	47,6%	52,4%
53	Chemical products	45,9%	54,1%
54	Federal Reserve banks, credit intermediation, and related activities	42,6%	57,4%
55	Broadcasting and telecommunications	40,5%	59,5%
56	Utilities	31,2%	68,8%
57	Oil and gas extraction	26,7%	73,3%
58	Petroleum and coal products	23,6%	76,4%
59	Farms	19,4%	80,6%
60	Rental and leasing services and lessors of intangible assets	18,5%	81,5%
61	Real estate	5,6%	94,4%
	Min	5,6%	8,2%
	Max	91,8%	94,4%
	Mean	63,4%	36,6%
	Median	66,8%	33,2%