

BACKGROUND PAPER TO THE 2014 WORLD DEVELOPMENT REPORT

Resource Reallocation and Innovation

Converting Enterprise Risks into Opportunities

Mark A. Dutz

The World Bank
Poverty Reduction and Economic Management Network
Economic Policy and Debt Department
July 2013



Abstract

This paper argues that the increased flow and management of knowledge permitted by knowledge-based capital, supported by appropriate policies, can be an important factor in reducing the decision risk facing enterprises due to uncertainty and imperfect information, helping improve the resilience of development outcomes. Enterprises are conceptualized as information platforms that manage risk through investments in knowledge-based capital and complementary assets, providing them with the knowledge, protection/enabling, insurance, and coping/leveraging abilities to make better decisions in response to shocks. Investments in knowledge-based capital allow enterprises to better convert voluntary but risky reallocation and innovation decisions into productivity and wealth-enhancing opportunities. They can help the enterprise sector as a whole and most people to self-protect and realize better jobs, earnings, and consumption outcomes by adapting to shocks. However, absent appropriate policies, knowledge-based capital can

have adverse distributional effects—including a skewed industrial concentration of productivity gains and more unequal consumption and income-earning outcomes between rich and poor people. The paper discusses the role of policy in facilitating risk management by enterprises, ultimately to reduce poverty and boost shared prosperity. Insufficient enterprise risk-taking is costly for the enterprise sector and the economy as it results in too little experimentation and learning. The paper argues that governments should create business environments that stimulate entrepreneurial risk-taking to invest in market and social opportunities that combine new technologies with appropriately-skilled workers. Policies allowing people to better confront and manage their risks include: (1) spurring entrepreneurial experimentation; (2) supporting skills upgrading; and (3) promoting mechanisms for joint learning through global collaboration.

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Resource Reallocation and Innovation: Converting Enterprise Risks into Opportunities

Background paper for World Development Report 2014: Managing Risk for Development

Mark A. Dutz¹

Keywords: Economic growth, risk, investment, intangible assets, knowledge-based capital, productivity, innovation

JEL Codes: D81, O47, O31, O32, E22, L16

¹ The paper is a product of the Economic Policy and Debt Department, Economic Policy Sector Board, Poverty Reduction and Economic Management Network, The World Bank. The author thanks in particular Charles Hulten and Xubei Luo for helpful suggestions on an earlier draft. The author may be contacted at mdutz@worldbank.org.

I. INTRODUCTION

Measurement of business spending on non-tangible knowledge assets or KBC (Knowledge-Based Capital) is relatively recent, with the seminal work applying direct expenditure methods initially done for the U.S. economy (OECD 1998, Nakamura 2001, Corrado, Hulten and Sichel or CHS 2005 and 2009).² In contrast to the conventional approach of treating spending on knowledge assets as intermediate expenditures and thereby assuming that all their benefits are reflected in the current year's output of tangible goods and services, the KBC approach correctly capitalizes outlays that contribute to production and value beyond the taxable year and treats them as longer-lived knowledge investments – using the same cost-based accounting that is used for physical capital. The KBC approach opens up the black box of conventional Total Factor Productivity by explicitly measuring key knowledge-related elements rather than estimating them as a residual. The CHS classification divides KBC into 3 categories:

- (1) *digital assets* (labeled “computerized information”) – what firms spend on databases and software to better measure, manage and reorganize what they are doing in light of changing external demand and supply conditions
- (2) *intellectual assets* (“innovative property”) – spending on R&D, creative assets, copyright and licensing costs, architectural, engineering and other designs, new products/systems in the financial industry, and mineral exploration and evaluation
- (3) *human-organizational assets* (“economic competencies”) – outlays on market research, advertising and brand equity, firm-specific human capital, and business process/organizational improvements.

The acceleration of globalization, technological progress, and increased trade and competition have resulted in rents from new ideas becoming more important for sustained firm-level competitiveness and aggregate growth across countries, but also in higher risks in the commercial exploitation of these ideas. As knowledge inputs are becoming a bigger share of value added and all countries are seeking ways to take advantage of information communication and related technologies in their transition to more knowledge-intensive economies, investments in the full range of activities needed to commercialize new ideas and create competitive advantage are becoming more important over time. The increasing importance of KBC over time is shown by the steady increase in the KBC investment rate in the US as a share of expanded nonfarm business output, from 8% in 1977 to 14% in 2010, in contrast with a secular decline in the tangible investment rate (Corrado and Hulten 2010, Hulten 2013).³ This is not unique to the developed high-income countries: Hulten and Hao (2012) estimate increases in KBC investments over time for China from 3.8% in 1990 to 7.5% as a fraction of GDP for the total economy, and Dutz et al. (2012b) estimate increases for Brazil from 3.5% in 2000 to 4.8% in 2008 as a fraction of GDP.

The KBC approach has expanded the conventional proximate measured sources of growth beyond human and physical capital to include knowledge investments in the resource reallocation/innovation and risk management capabilities of the enterprise. Importantly, these investments go significantly beyond traditionally-measured R&D expenditures to include a range of co-investments required for enterprises to

² See Corrado, Haskel, Jona-Lasinio and Iommi (2012) for an application to advanced economies, Dutz et al. (2012b) to Brazil, Hulten and Hao (2012) to China, and Hulten, Hao and Jaeger (2012) to India.

³ In the UK, business investment in KBC is estimated to have more than doubled as a share of market sector gross value added between 1970 and 2004. For similar data on other developed high-income countries, see OECD (2013).

decide what to produce and how, to develop new ideas, and to execute and translate these ideas into products, processes and markets – outlays such as market research and databases, design and marketing, skills, management systems including how to get the right people into the right jobs, and joint learning through collaborative networks. Estimates of KBC at the aggregate level across countries, to-date available mainly for high-income OECD countries but also for Brazil, China and India, highlight that KBC is an important element of aggregate economic growth, with a significant positive correlation between investments in “core” KBC (excluding software and architectural and engineering designs to control for the links with IT equipment investment and real estate bubbles) and PPP-adjusted output per capita (Hulten 2013, OECD 2013).⁴

This paper explores the implications of explicitly expanding the range of applicability of the concept of KBC to the risk management challenges that enterprises face – including both exogenous risks arising from unexpected shocks and changing demand and supply trends as well as the endogenous risks arising from voluntary resource reallocation and innovation investments that firms take in the pursuit of opportunities for better expected rates of return. Investments in different types of KBC are consequently conceptualized as investments in both resource reallocation/innovation and risk management capabilities, including investments to manage the risks associated with reallocation and innovation such as outlays on knowledge about emerging new technologies and changes in consumer preferences, on software and databases to build capabilities for more flexible adjustment, and on internal organizational routines to learn from failures: KBC investments allow enterprises to better convert voluntary but risky reallocation and innovation decisions into productivity and wealth-enhancing opportunities, and to better cope if the associated investments don’t turn out as anticipated.⁵ In addition, the types of measured KBC are expanded in this paper to include an additional-to-CHS sub-category likely most important for developing country industries behind the global technological frontier, namely spending on collaboration-related assets to diffuse, capture, adapt to local context and use existing but new-to-the-firm knowledge, such as outlays on networking and peer-to-peer learning from global value chains and from foreign buyers and sellers, from consultants and study tours, and from other forms of global knowledge. The paper maps the main types of KBC investments into the four pillars of risk managed initially proposed by Ehrlich and Becker (1972), namely: investments in *knowledge* of supply and demand trends and the likelihood of shocks; investments in *protection/enabling* to reduce the probability of losses and increase the probability of successful reallocation and innovation; investments in *insurance* to reduce the size of losses by transferring resources from good to bad times; investments in *coping/leveraging* for *ex post* loss recovery or benefit enlargement if the investments in reallocation and innovation are successful in the marketplace. As an illustration, the paper applies this framework to investments in KBC that have supported enterprise risk management in the Chilean wine industry.

⁴ One particular type of economic competencies-related KBC that has recently benefited from empirical studies in developing countries is “managerial capital”. See Bruhn et al. (2010) for an overview, and the complementary findings of Bloom et al. (2013a) on the impact of intensive consulting services from an international firm on the business practices of 20 large Indian textile experimental plants, and Bruhn et al. (2013) on the impact of a heterogeneous set of local consulting firms on 80 small and medium-sized Mexican firms across industries taking the support, with both studies finding that access to management consulting leads to better enterprise performance.

⁵ A number of recent papers, such as Andrews and Criscuolo (2013), Hulten (2013) and OECD (2013) examine key linkages between KBC, resource reallocation and innovation, but do not explicitly consider the role of KBC in facilitating enterprise risk management.

In its analysis, the paper explores the role of resource reallocation and innovation decisions in adjusting to and leveraging risks and the supportive role of KBC – rather than other complementary mechanisms of enterprise risk management. Section II discusses how the enterprise sector manages risk, with a focus on KBC as investments in resource reallocation/innovation and risk management capabilities. Section III then explores how enterprise risk management through reallocation and innovation can help people better manage risks, both indirectly through its impact on the enterprise sector, and directly through its impact on people as consumers and as income earners. Section IV explores the role of public policy, focusing on three possible intervention areas: (1) spurring entrepreneurial experimentation – by setting the rules of the game in the business environment for the allocation of entrepreneurial talent towards innovation including reducing distortionary “costs of success” and “costs of failure”, and ensuring sufficiently flexible and competitive product and factor markets with as much policy certainty as possible; (2) supporting skills upgrading – by investing in human capital and facilitating people to invest in themselves through enterprise-driven on-the-job and vocational training, and reinforcing urban agglomerations of enterprises and people for enhanced knowledge spillovers; and (3) promoting mechanisms for joint learning through global collaboration – by facilitating firms’ connecting to and learning from global value chains, universities and their extended communities, and the relevant national diaspora, supported by open data platforms. A final concluding section suggests some outstanding issues that could benefit from further measurement, analysis, policy experimentation and learning.

II. HOW DOES THE ENTERPRISE SECTOR MANAGE RISK?

This section explores how efficient risk management by firms involves both reallocation and innovation decisions, and how investments in KBC (together with investments in complementary assets) enable firms to make appropriate decisions in the face of exogenous shocks, and to pursue voluntary but risky reallocation and innovation decisions that can be turned into opportunities for profitable growth.

II.1 Resource reallocation and innovation as risk management

As a desired societal outcome, efficient resource reallocation within each enterprise (and by implication across firms within industries and across industries) and innovation should jointly reflect efficient risk management by enterprises – allowing risks to be confronted and wherever possible turned into opportunities:

*“efficient risk management by firms → efficient reallocation & innovation → shared prosperity”
= more resilient development outcomes for most people.*

A variety of market and government failures, including a range of frictions and adjustment costs, typically prevent the full extent of these outcomes from being realized.

All enterprises, both formal and informal production units and their direct stakeholders (financiers, owners, managers and workers) are exposed to a range of risks, including risks imposed from outside the firm (exogenous risks) and risks that firms choose to take in pursuit of higher profit (endogenous risks).⁶ Exposure to risk matters to firms and to the economy, and matters even more for developing countries.

⁶ Exogenous risks include *imposed* productivity and/or demand shocks (both first-moment changes in levels and second-moment increases in volatility or “uncertainty shocks”) arising from unanticipated external-to-the-firm changes in input and output prices (and other non-price effects) due to natural/weather disasters, pandemic

To explore whether exogenous risks reduce growth, or whether the direction of causality runs the other way with recessions increasing uncertainty, Baker and Bloom (2012) examine the impact on GDP growth of over 1,000 unanticipated exogenous shocks for 60 countries, both developed and developing, since 1970. Their identifying assumption is that some shocks, like natural disasters, lead primarily to a change in stock-market levels so are more first-moment shocks, while other shocks like political coups lead more to changes in stock-market volatility, implying they are more second-moment shocks. They find a significant causal impact of both first and second moment shocks on growth: in the quarter following a shock, they estimate that a one standard deviation reduction in stock-market levels and a one standard deviation increase in stock-market volatility each lead to a 1.9% reduction in GDP; and in the year following the shock, they estimate larger effects, with the same changes leading to falls in annual GDP growth of 2.8% and 6.3%, respectively. So both first and second moment shocks have a significant negative impact on growth, with second moment effects having equal or higher impact. To explore the extent to which these results differ across countries, they first include interactions with being a “rich” country, defined as being above the sample-average GDP per capita of \$25,000, and find no significant effect – suggesting that shocks have the same impact on rich and poor countries alike. However, the higher frequency of disaster shocks in developing countries implies that the greater uncertainty there has more negative effects on growth and other variables. In addition, they find that less financially developed countries and those with stricter labor regulations⁷ have a significantly larger negative impact of uncertainty shocks (with no difference in response to first-moment shocks) – suggesting that incompleteness of financial markets and rigidities in labor markets are two important channels for the impact of risk on firms.

An important part of the plant-specific risks faced by firms, at least in the US, appears to be due to the greater degree of innovations and creative destruction in some industries relative to others. To develop a better understanding of the cross-industry variation of plant-level idiosyncratic shocks, Castro, Clementi and Lee (2011) examine annual US manufacturing data over the 25 year period 1972-97.⁸ They find considerable variation in idiosyncratic risk across industries: plants in the most volatile industries are subject to at least 3 times as much risk as plants in the least volatile.⁹ To explore why certain industries have so much greater variation in the growth of productivity, they propose that the heterogeneity in idiosyncratic risk is driven by the differential extent to which creative destruction shapes competition

risks/illness of the workforce, resource risks, geopolitical risk and social unrest/strikes, infrastructure risks, other economic, financial, and regulatory risks, and changing trends over time in technology and tastes. Bloom (2009) highlights the importance to policymakers of distinguishing between the more persistent first-moment effects and the more temporary second-moment effects of major shocks (with the increased volatility of “uncertainty shocks” typically generating a rapid and costly slowdown followed by a bounce-back in enterprise investment, hiring and productivity growth). Endogenous risks are *voluntary* resource reallocation and innovation investments firms take in the pursuit of opportunities for better expected rates of return.

⁷ Their measure of financial development is generated by the World Economic Forum (ranking countries according to the strength of their financial markets and the depth and breadth of access to capital and financial services), while the labor regulation measure is the World Bank’s Doing Business indicator of the strictness of hiring, firing and contract change regulations.

⁸ Their data are comprised of 50-70,000 plants per year distributed over 140 three-digit industries

⁹ Their proxy for risk is the volatility of the portion of Total Factor Productivity (TFP) growth which cannot be forecast by means of factors, either known or unknown to the econometrician, that are systematically related to plant dynamics (which is not explained by either industry- or economy-wide factors, or by plants’ characteristics systematically associated with changes in TFP itself): the volatility of TFP growth due to idiosyncratic shocks ranges from 4% for producers of fur goods to 12.4% for manufacturers of computer equipment.

across industries. They find that their measure of idiosyncratic risk is significantly positively associated with industry measures of product turnover, R&D, and investment-specific technological change.¹⁰

Enterprises respond to these and other exogenous risks by undertaking accommodating endogenous risky investments through two types of investment decisions, *reallocating resources and/or innovating*¹¹ – in addition to mechanisms such as limiting the down-side risk of capital owners through limited liability, and limiting excessive fluctuations in employment and income of their workers through employment contracts. Reallocation and innovation, in turn, are typically facilitated by a more flexible and formal enterprise sector. Flexibility in the enterprise sector, namely a greater extent of “creative destruction” driven by both more reallocation and innovation (enterprise expansion, contraction, exit and re-entry with better ways of producing), is important for enterprise risk management as it facilitates experimentation and learning in response to shocks. Insufficient entrepreneurial experimentation and enterprise risk-taking is costly for the enterprise sector as a whole because it results in too little investment in knowledge and knowledge spillovers, and prevents the efficient reallocation of resources towards more productive activities and the introduction of better ways of producing in response to supply and demand shocks and changing trends over time. The main risk management problem facing informal enterprises, on the other hand, is that they typically have only limited access to financial markets, professional management, foreign partners, and other essential channels to access, adopt and better use global knowledge – which limits their ability to adjust to shocks and changing trends.¹² As enterprises are able to take advantage of

¹⁰ Their industry-level proxies for product turnover, R&D and investment-specific technological change (ISTC) are, respectively: the monthly item substitution rate as collected by the US Bureau of Labor Statistics from sales outlets on more than 300 consumer good categories; the industry’s average ratio of R&D expenditures to sales in COMPUSTAT; and a time series of quality improvements collected by Cummins and Violante (2002). On average, 1% increase higher product substitution rate implies 0.25% higher volatility of TFP growth, 1% increase in R&D intensity implies 30% volatility increase, and 1% increase in ISTC is associated with 0.93% volatility increase.

¹¹ Enterprise resource reallocation involves expansion or contraction of factors of production while doing more or less of the same things, namely shifting resources across existing goods and services that the enterprise produces, including exiting some or all product lines. Enterprise innovation, on the other hand, is broadly defined as the commercialization through markets by entrepreneurs of improvements in technology, where technology captures transformations of inputs into outputs including improvements in products, processes, business processes/organization, and marketing – namely doing any productive activity in better ways by making progress over and above the duplication of physical capital and labor. In the context of development, innovations should be recognized as applying to a broader range of non-replicative entrepreneurial accomplishments than just new-to-the-world frontier products, and include value and productivity-enhancing activities that commercialize ideas that are new-to-the-firm – thereby including the adoption, adaptation to local context and use of technologies already used elsewhere but not yet used in the local economy (see Dutz et al. 2012a). Innovation can be measured as the within-firm component of TFP growth (see Dutz 2013). In addition to being a source of endogenous risk, innovation helps firms manage exogenous shocks that require more adaptation than just reallocation of resources. There are of course important interactions between the two: ease of reallocation affects the expected profitability of innovation, while innovation typically requires complementary reallocation of resources.

¹² The informal sector typically exhibits more flexible reallocation only when government policies overly constrain the formal sector’s flexibility. In Turkey, for instance, the share of informality increased in growing non-agricultural employment between 2004 and 2010 in the Anatolian East due to rigid and costly labor market rules facing formal enterprises, including a very expensive severance payment regime leading to one of OECD’s most rigid employment protection rules for permanent workers, and the most restrictive rules for temporary contracts among OECD countries (Gonenc et al. 2012). Taymaz (2009) suggests that the significant productivity gap between informal and formal firms, and wage gap between informal and formal workers, can be traced back to differences in professional and technical skills of owners and managers, with more educated entrepreneurs and workers moving to the formal sector. This process of self-selection contributes to widen the productivity gap between informal and formal enterprises.

these benefits of formality and grow, they concurrently invest more in the types of intangible assets that allow them to better manage risks and growth in productivity, output and employment terms.¹³

Regarding the effect of risk on resource reallocation, Bloom et al. (2012a) show that the dynamics in enterprise output following exogenous uncertainty shocks arise from three complementary enterprise decision channels: labor, capital, and the misallocation of factors of production. An increase in uncertainty provides an option value from waiting, increasing the returns to inaction and leading to significant falls in hiring, investment and output.¹⁴ When uncertainty increases, most firms pause hiring, as labor cost adjustments make hiring or firing mistakes more costly. The labor force drops as worker attrition continues without replacement hires. Investment similarly falls, with a drop in the capital stock as existing capital depreciates without being replaced. Finally, increased uncertainty also reduces TFP (Total Factor Productivity) growth by reducing the degree of resource reallocation in the economy. As firms reduce expansion and contraction with the uncertainty shock, any desirable productivity-enhancing reallocation across firms (with unproductive firms contracting and productive firms expanding) is also slowed down.

Regarding the effect of risk on innovation across firms, Bloom and colleagues (2013b) show how a downside shock or unanticipated adversity, such as an increase in import competition from lower-cost countries, can cause enterprises to innovate relatively more if factors of production are trapped inside the enterprise, leading to a natural friction or adjustment cost constraining reallocation of factors of production between firms. The case study examples given all relate to the presence of different types of KBC, such as skilled engineers and R&D and design capabilities, skilled employees whose human capital is specific to the firm and will be lost if they move to other firms, brand capital, and organizational resources. When the shock reduces the price of one or more of the products that the firm produces, the opportunity cost goes down for the trapped inputs within the firm. This behavior has been confirmed across countries that faced a large increase in import competition: individual firms that faced more import competition exhibited a bigger increase in innovation, increasing their R&D expenditure, patenting and adoption of IT (Bloom et al. 2012b).

Caggese (2012) finds that an increase in exogenous uncertainty has a large negative effect on innovation of entrepreneurial firms, with the negative effect being stronger for less diversified entrepreneurial firms – and with no effect of exogenous uncertainty on innovation of more diversified publicly-owned firms.¹⁵

¹³ Hsieh and Klenow (2013) examine the importance of resource misallocations that prevent young efficient firms from growing and that punish larger firms over the enterprises' life cycle. Comparing the life cycle of manufacturing enterprises in India and Mexico to the US, they conclude that differences in "within-firm TFP" (that part of aggregate TFP growth that does not come from cross-industry or within-industry cross-enterprise resource reallocation) –as successful US firms grow and accumulate intangible capital and complementary assets while Indian and Mexican firms exhibit little growth in terms of TFP, output and employment, and concurrently also exhibit lower post-entry investment in intangible capital– account for an important part of the gap in aggregate TFP between poor and rich countries. Bollard, Klenow and Sharma (2013) similarly report the importance of "within-firm TFP", namely the productivity growth within existing large plants rather than reallocation across plants, in accounting for the rapid productivity growth in Indian manufacturing from 1993 to 2007.

¹⁴ They find that reasonably calibrated uncertainty shocks can explain drops and rebounds in GDP of around 3%.

¹⁵ Based on a panel of 11,417 Italian manufacturing firms over 1992-2001, a 1% increase in uncertainty lagged one period leads to a 0.69% fall in the frequency of innovations of all entrepreneurial firms, and a 0.92% fall for the group of less diversified/smaller entrepreneurial firms.

The difference in innovation response across firms appears to be importantly driven by market imperfections, namely the inability of entrepreneurial firms to diversify their risk.¹⁶ Because of these capital market imperfections, entrepreneurial households typically have most of their wealth invested in their own businesses.¹⁷ In response to an increase in exogenous uncertainty, the main instrument to rebalance the risk-return profile of their assets is the choice of the riskiness of their investment projects. The same effect does not operate in publicly-owned firms, in which the firm's manager is exposed only to a fraction of the firm's risk and can more easily diversify it. One implication of this line of findings, given that developing countries experience more shocks than developed countries, is for enterprises to invest more, wherever appropriate, in lower-risk "new-to-the-firm" adaptive-type innovation rather than riskier "new-to-the-world" frontier-type innovation.

II.2 KBC as investments in enterprise risk management

Investments by firms in KBC and complementary physical assets are largely investments in enterprises' pillars of risk management, and thereby (by providing firms with the knowledge, enabling and leveraging abilities to more effectively develop and commercialize new-to-the-firm technologies, and better self-protect and cope if the innovation investments don't turn out) are also investments in innovation capacity and in the resilience of development outcomes.

The four traditional pillars of risk management include acquiring **knowledge** of shocks, exposure and potential outcomes, building **protection** to reduce the probability of losses and increase that of benefits, obtaining **insurance** to reduce the size of losses by transferring and hedging resources from good to bad times, and **coping** to recover from losses and make the most of benefits; the first three represent *ex ante* preparation for risk while the fourth represents *ex post* risk management (Ehrlich and Becker, 1972). Investments by firms in KBC for reallocation and innovation activities, coupled with complementary investments in physical assets, can be interpreted largely as investments in these pillars of risk management, to help reduce the downside risks of negative returns and also to increase the positive returns associated with successful innovation (some industries are characterized by very asymmetrically skewed variance of returns from innovation-related investments, with large positive returns for the successful innovator and negative returns for unsuccessful firms).

Figure 1 presents available data on KBC accumulation in Brazil, China and India relative to the U.S. The data highlight that investments in a broad range of KBC types, going significantly beyond R&D expenditures, are taking place.¹⁸ R&D has typically been easiest to measure, and therefore the focus of

¹⁶ It appears not to be driven by risk-loving preferences of entrepreneurs, as experimental studies generally find entrepreneurs to be as risk averse as, and some studies find them to be even more risk averse than non-entrepreneurs. See Sarasvathy, Simon and Lave (1998), Miner and Raju (2004) and Hongwei and Ruef (2004).

¹⁷ Herranz, Krasa and Villamil (2009) find that, even in the US, 2% of the primary owners of small businesses invested more than 80% of their personal net worth in their firms, 8% invested more than 60%, and about 20% invested more than 40%.

¹⁸ Corrado, Haskel, Jona-Lasinio and Iommi (2012) show why investments in KBC matter for total factor productivity growth (TFPG), by comparing the correlation of investment in physical capital to TFPG versus the correlation of investment in KBC to TFPG across a range of developed and emerging market countries. There is a much stronger positive correlation between KBC and TFPG, consistent with strong spillover effects; for instance, when one firm invests in software, design, business process improvements or R&D, not only does that firm become more productive but other firms also benefit over time, which is good for overall productivity and provides a rationale for policy intervention.

much previous analysis, even though R&D spending is typically less than a quarter of spending on KBC; and there is a presumption that most econometric studies showing large returns to R&D suffer from misspecification due to non-included complementary KBC variables, with returns to other types of KBC incorrectly attributed to R&D. Spending on existing types of economic competencies is the most important broad category in the US, but less important in emerging economies, with reported spending on training particularly low.¹⁹ Importantly, there is recent evidence that the measurement of global collaboration-related economic competencies as an additional type of KBC is important for developing countries, namely investments in joint learning through collaborating with global value chains to facilitate the capture and use of existing global knowledge that is new-to-the-firm (see Box 1).²⁰

Figure 1: KBC investments as % of expanded GDP, 2006

	US		China		Brazil		India	
1. COMPUTERIZED INFORMATION	1.24	12%	1.88	27%	1.10	26%	0.22	8%
2. INNOVATIVE PROPERTY	4.07	39%	3.40	48%	2.01	47%	1.48	56%
Research and Development (R&D)	1.69	16%	1.02	14%	0.56	13%	0.80	30%
Mineral exploration & evaluation	0.78	8%	0.21	3%	0.03	1%	0.00	0%
Copyright & license costs	0.55	5%	0.08	1%	0.11	3%	0.05	2%
Development costs in financial ind.	0.55	5%	0.47	7%	1.10	26%	0.38	14%
Designs, incl. architectural & engineering	0.50	5%	1.62	23%	0.21	5%	0.25	9%
3. ECONOMIC COMPETENCIES	5.04	49%	1.80	25%	1.17	27%	0.95	36%
Reputation & Branding	1.35	13%	0.38	5%	0.56	13%	0.11	4%
Advertising expenditure	1.24	12%	0.38	5%	0.51	12%	-	-
Market research/Branding	0.11	1%	-	-	0.05	1%	-	-
Training & Development	1.05	10%	0.29	4%	0.34	8%	0.01	0%
Continuing vocational training	-	-	0.29	4%	-	-	-	-
Apprentice training	-	-	-	-	-	-	-	-
Business process improvements	2.64	26%	1.13	16%	0.27	6%	0.83	31%
Purchased	-	-	-	-	0.03	1%	-	-
Own-account	-	-	1.13	16%	0.24	6%	-	-
TOTAL INVESTMENT IN KBC	10.35	100%	7.08	100%	4.28	100%	2.65	100%

Source: Dutz et al. (2012b), Hulten and Hao (2012), Hulten, Hao and Jaeger (2012).

In addition to being an important source of total investment and growth, different types of enterprise investments in KBC play a critical role as investments in enterprises' pillars of risk management,

¹⁹ This aligns with related findings from Bloom and Van Reenen (2010) on measuring management practices of medium and large manufacturing firms covering monitoring (collection and processing of production data), target setting (whether coherent and binding on operations, inventory and quality control), and worker incentives (merit-based pay, promotion, hiring & firing), where Brazil, China and India are at the bottom of the table relative to industrialized countries. It should be mentioned, however, that there is no presumption that US spending levels on KBC are optimal, either for the US or for other countries, and emerging market spending may be appropriate given local returns to different types of KBC (and are no doubt linked to other drivers of investment patterns such as endowments, industrial structure, technological capabilities, and the broader business environment).

²⁰ The original KBC measurement agenda was launched by a request from then-US Fed Chairman Greenspan, and the types of KBC selected were driven by their perceived importance to the US economy, where a number of firms are relatively close to the technological frontier. Economic competencies related to the capture and learning from existing global knowledge is arguably less important for the US than for countries where most firms are relatively more distant from the prevailing global technological frontier.

providing enterprises with essential capabilities to anticipate, absorb and adapt to exogenous risks, and undertake endogenous risks in pursuit of larger expected profits with higher probabilities of success – empowering firms to learn and execute in their risky environments as enabled information platforms.²¹ The main types of traditionally-measured KBC investments can be relatively easily mapped into the four pillars of risk managed initially proposed by Ehrlich and Becker (1972), namely:²²

- Investments in *knowledge* of supply and demand trends and the likelihood of shocks, including changes in existing and emerging new global technologies and changes in consumer preferences – based on investments in R&D, and in global connectivity (including investments in knowledge diffusion networks and various search and match mechanisms to learn from and co-create with other local firms, global corporate partners, suppliers and buyers, universities and their extended communities, and the diaspora, and investments in local knowledge networks by informal enterprises).
- Investments in *protection/enabling* to reduce the probability of losses and increase the probability of successful reallocation and innovation –based on investments in market research, branding and advertising to expand product varieties and market reach and thereby diversify location-specific product risks both on production and demand sides– as the optimal reallocation of resources under uncertainty may not be to invest all into a high-risk new technology, but to invest some resources in the existing technology and benefit from the option value of waiting until some additional uncertainties are resolved.²³ D’Erasmus and Moscoso Boedo (2012) show that firm-level volatility is negatively correlated with such intangible expenditures: firms that incur higher intangible expenses are able to serve more markets and thereby diversify and reduce market-specific demand risk.²⁴

²¹ See Hulten (2013) on some policy implications of conceptualizing the firm as an information platform.

²² Sheffi (2005) surveys a wide range of largely intangible investments spanning the four pillars that firms have made to increase knowledge, self-protect, insure against and cope with low-probability high-impact disruptions, broken down into “reducing vulnerability” (early detection and security investments in databases and software to reduce the likelihood of intentional disruptions from industrial actions, sabotage or terrorism), “building resilience through redundancy” (investments in slack, non-used inventory, capacity and IT systems, and increased holdings of retained earnings) and “building resilience through flexibility” (investments in new business models to allow interchangeability of plants, parts and people, realign supplier relations in supply chains, and modify internal culture towards greater safety, quality, continuous communications, and conditioning for disruptions).

²³ Bloom et al. (2007) show that higher uncertainty reduces the responsiveness of investment to demand shocks, with uncertainty increasing real option values and making firms more cautious when investing or disinvesting (firms only hire and invest when business conditions are sufficiently good, and only fire and disinvest when they are sufficiently bad; when uncertainty is higher, this region of inaction expands, as firms become more cautious in responding to business conditions). Investment is also shown to have a convex response to positive demand shocks, magnifying the response, and a concave response to negative demand shocks. Empirically, these ‘cautionary’ and ‘convexity’ effects of uncertainty are large and play an economically important role in shaping firm-level investment decisions, with a one-standard deviation increase in their measure of uncertainty (like that which occurred after September 11, 2001 and the 1973 oil crisis can halve the impact effect of demand shocks on enterprise investment. This implies that the responsiveness of firms to any given policy stimulus may be much weaker in periods of high uncertainty, suggesting that countries where firms face systematically higher uncertainty may require significantly higher levels of stimulus to achieve a comparable impact.

²⁴ The authors find a significant negative relationship between firm-level idiosyncratic volatility and intangible expenses, based on US data from the Kauffman Firm Survey and Compustat both for a general measure of intangibles (selling, general and administrative expenses) and for advertising expenditures, and controlling for industry-time fixed effects and a time trend: their results imply that if the top quartile firm of the intangible expenses distribution in the Compustat sample (a firm with \$84 million in intangible expenses) reduces expenditures to that of the median firm, its volatility would increase by roughly 23%. Their proxy for risk is the volatility of the portion of growth in sales which is not explained by either industry or economy-wide time effects, or firm characteristics

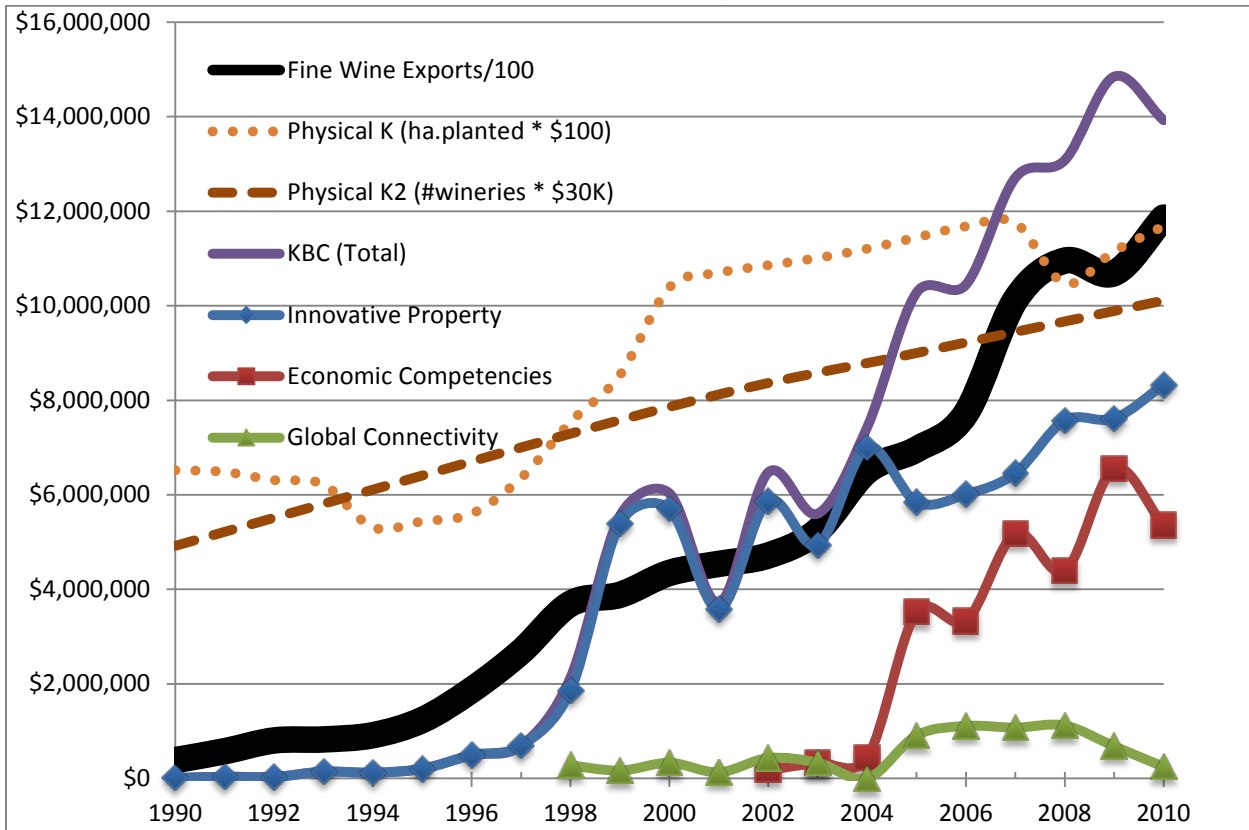
- Investments in *insurance* to reduce the size of losses by transferring resources from good to bad times – based on including investments in private or public-private partnerships to pool and share risks such as an agreement with an OEM or with a large distribution chain that provides a resource cushion in temporary downturns and signals lower risk to investors, or investments by start-ups in patents to raise their salvage value if they go bust. Another example is the *ex ante* investment by formal firms in database rosters of specialized experts which can be tapped on-call when the need arises and by informal enterprises in local contacts, rather than *ex post* after the realization of a shock having to search and set up new contractual or non-contractual arrangements. According to Bartelsman (2012), it may be that firms operating in industries that are more prone to high idiosyncratic shocks invest more heavily in ICT (and associated KBC) to lower adjustment costs and smooth profit flows. Insurance-related investments also include efforts by enterprises, households and cities to obtain insurance from the government either directly (anti-dumping, temporary import tariff protection, flood insurance subsidies) or through investment in physical infrastructure.
- Investments in *coping/leveraging* for *ex post* loss recovery or benefit enlargement if the investments in reallocation and innovation are successful in the marketplace, including investments in worker and management continuous learning, business process improvements, and software and databases to build up enterprise capabilities for more flexible adjustment, facilitating either scaling up or down, depending on the realization of the shock.

Box 1 documents investments in the main traditional types of KBC plus spending on collaboration-related assets linked to global connectivity and their association with export performance in the Chilean wine industry over the period 1990-2010. It provides illustrative examples of how specific KBC investments can be re-interpreted as risk management tools according to the four pillars of knowledge, protection/enabling, insurance, and coping/leveraging.

Box 1. KBC and risk management in the Chilean wine industry. The main risks facing the Chilean vine-growing and wine-making industry over the past years were shifts in local inputs and in global demand and supply, exchange rate volatility, and natural disaster risks including viticultural pests and disease hazards, water and temperature variability, and earthquakes. Investments in different types of KBC and complementary physical capital by Chile’s wine-producing enterprises have enabled the industry to absorb shocks, innovate and grow exports at stunning rates of 25% per annum in the 1990s and 10% per annum in the 2000s while avoiding excessive volatility – leading Chile to be in the global top five in terms of value and volume of wine export national shares by the late 2000s (ahead of the US, Germany, New Zealand, Argentina and South Africa, among others). Figure 2 shows the association between investments in KBC relative to investments in tangible assets and changing export levels over the past two decades. In particular, it suggests that total measured investments in KBC, as the sum expenditures on of innovative property (investments in R&D), traditionally-measured economic competencies (outlays on market research, marketing, training and business process improvements) and global connectivity, are more closely correlated with bottled wine exports than available proxies for investments in physical capital (area planted or number of wineries).

associated with growth such as the firm’s age or size; all results are robust to a measure of idiosyncratic risk derived from TFP at the firm level.

Figure 2: KBC and Chilean wine exports (real 2012 USD)



Source: Dutz and Troncoso (2013)

Examples of investments in KBC that support enterprise risk management include:

(i) Investments in **knowledge**. An example of adjusting to the risks of losing market share when foreign competitors innovate is Miguel Torres' (a Spanish-owned FDI firm) first introduction in Chile of temperature-controlled stainless steel vats instead of the traditional concrete fermenting vats that did not allow temperature control and retained residues adversely affecting taste and smell, widespread in use in high-income countries. This led Chilean-owned vineyards to introduce them – and required additional investments in technical support and local learning, as no one in Chile knew how to assemble them.²⁵ To further lower the risk of falling behind the evolving technological frontier, Chile's Production Development Corporation (CORFO, a governmental organization to promote investment and innovation) and participating enterprises co-invested \$5.1 million between 2005 and 2010 in 38 foreign technological study tours ('misiones tecnologicas') and in 15 foreign consultancies by oenologists, viticulturalists and other global experts ('consultorias especializadas').²⁶ And to lower the risk of volatile exports for smaller

²⁵ The investment in local assembly of stainless steel vats, and the complementary physical capital investments, "an apparently minor innovation", allowed enterprises to export wines sanitarly safely and with reduced variability and higher quality and taste to international standards across vintages (Agosin and Bravo-Ortega, 2009).

²⁶ The average private contribution to these global connectivity projects was 40%. The use of global oenologists as foreign consultants also allowed Chilean enterprises to lower the risk of changing global tastes, as they acquired knowledge of the characteristics of changing international demand and began making Chilean wines to those specifications (Agosin and Bravo-Ortega 2009).

producers with less widespread distribution networks as well as to increase export levels, CORFO's Associative Development Projects (PROFOS, a program to strengthen the technology absorption and joint marketing capabilities of associations of independent small and medium-scale enterprises) and participating enterprises co-invested \$11.5 million between 2005 and 2010 in a range of initiatives to learn how to best promote local wine regions, thereby developing a ready buyers' market and strengthening customer loyalty, reducing the volatility of demand by making demand more price-inelastic.²⁷

(ii) Investments in **protection/enabling**. Chile's ideal geographical isolation (desert in the North, mountains to the East, Antarctic to the South, and Pacific to the West) has historically protected it from viticultural hazards such as the phylloxera louse.²⁸ Chile's government, through its Agriculture and Livestock Service (SAG), invested in rigorous zoo- and phyto-sanitary border control, to protect this natural low-risk factor underpinning its agricultural competitiveness. An example of KBC to protect vine production against disaster risks such as pests and diseases as well as climate change-induced drought and temperature variability is the co-investment of \$1.2 million between 2004 and 2012 by the Fund for fostering Scientific and Technological Research (FONDEF, a program of Chile's National Commission for Scientific and Technological Research CONICYT).²⁹ The co-investment resulted in a major study on adapting root stock and cultivar grafting to local conditions, generating the know-how to graft local vines on North American grapevine rootstocks and thereby providing resistance to parasites, ensuring local adaptation to changing water and temperature conditions, helping regulate the vigor of vine foliage to changing external conditions, and allowing lower-cost adaptation to other changing conditions such as soil salinity. Other protection against increasing drought as melt-water from the Andes diminishes was provided by investments in drip irrigation, which also enables more precise computer control of both watering and fertilizer, but required complementary investment in worker training.

(iii) Investments in **insurance**. An example of insurance-related KBC is an investment in 2003 in a detailed census of all winemaking enterprises to document and benchmark their existing storage capacity, in order to stimulate investment in storage capacity as a shock absorber of volatile world market wine prices together with exchange rate risk – allowing smoothing of export supply to markets depending on varying earnings potential from year to year. Investment in additional storage capacity also serves as insurance against risk of loss of product from leaking vats as a result of unpredictable earthquakes, minimizing the marketing risks associated with foreign customers not being assured of continuous delivery of product and possibly switching to other countries' product. Finally, an example of investing in KBC to insure against the risk of future continued appreciation of the exchange rate by lowering local costs is the co-investment of \$725,000 between 2008 and 2011 by the Foundation for Agrarian Innovation (FIA, a developmental agency of the Ministry of Agriculture) and participating enterprises in R&D and an

²⁷ In addition to 21 PROFOS, these collaborative investments in marketing also included 18 additional local wine tourism regional development initiatives, and 4 regional export development initiatives (e.g. "for Asia"). The average private contribution to these collaborative marketing projects was 47%.

²⁸ Phylloxera devastated European wine production in the 1860s and led to widespread unemployment. Over time, it even affected Argentina just across the Andes. Chile is the only winemaking country in the world free of phylloxera, and has not been affected to-date.

²⁹ FONDEF does not fund research if there is not a substantial provision of resources by the private sector: in this case, FONDEF provided 29% of funding, with 12 wineries and 4 nurseries providing 38%, and the University of Talca providing the remaining 33%.

economic evaluation of sparkling wine based on a traditional low-value grape variety (Pais, or Mission in California) – which dramatically lowered the cost of producing a good-quality sparkling export wine.

(iv) Investments in **coping/leveraging**. An example of coping/leveraging-related KBC is the \$15.3 million joint public-private investment in training between 2005 and 2010 to upgrade worker skills to increasingly sophisticated vineyard farming and winemaking techniques.

Box 2 provides an illustration of how an assessment of different types of KBC is motivated by banks' desire to better understand companies' strengths and weaknesses during their rating measurement and financial support decisions.

Box 2. The use of KBC in BNDES's credit analysis approach. BNDES, the Brazilian Federal Development Bank, has broadened its approach to credit analysis beyond its traditional focus on financial features associated with collateral to reduce the likelihood of default. It is now explicitly considering companies' investments in intangible assets, as they constitute investments in "dynamic capabilities... related to the firm's ability to identify opportunities and risks in its external and internal environment, and rearrange its tangible and intangible assets, if necessary" (Tenorio, Braga and Barboza (2013), p. 6 and Mendes and Braga (2010), p. 156).

In 2007, a Working Group was set up by BNDES to develop intangible assets measurement, in partnership with COPPE/UFRJ (Coimbra Institute for Graduate Studies and Research in Engineering, part of the Federal University of Rio de Janeiro). In 2010, the BNDES Board approved start of implementation of a "Methodology to Assess Intangible Assets and Competitiveness", to analyze the non-financial features of companies that BNDES supports. The Methodology is intended to allow BNDES bankers to better understand clients' strengths and weaknesses during the financial support decision: "it decreases BNDES' risk and improves support as loans can be applied to finance not only an investment project but the development and improvement of intangible assets" (p.11 and p. 159).

The developed questionnaire allows a rating of companies according to 28 questions on intangible assets, broken down into 7 types of KBC: (1) production and innovation, including innovation management; (2) corporate strategy, including strategies enabling the company to compete on price, sales effort and product differentiation in accordance with the prevailing competition in the company's external environment; (3) external relations, including relations with suppliers and clients; (4) financial policies; (5) corporate governance; (6) environmental and social issues, including reputation and sustainability; and (7) human resources. For each type of KBC, the guiding questions point toward the main aspects which must be considered by the evaluating bankers according to a 5-point scale, with level 5 representing the benchmark for each question. The assessment is based on the company's skills and capabilities, as well as on its investments to reach higher levels. The BNDES Human Resources Division is implementing a training program for 450 of its employees, and the IT staff already developed software to support application of the Methodology. 98 companies have been evaluated using the Methodology to-date.

III. HOW DOES ENTERPRISE RISK MANAGEMENT THROUGH REALLOCATION AND INNOVATION IMPACT PEOPLE?

This section discusses how resource reallocation and innovation supported by investments in KBC can help most people better manage risks, both indirectly through their impact on the enterprise sector's risk management, and directly through their impact on people as consumers and as owners of physical capital, ideas/technologies and labor.

III.1 Impact on the enterprise sector

Efficient resource reallocation and innovation by enterprises can positively affect the risk management of the enterprise sector as a whole, by helping all enterprises to self-protect and capture opportunities from better adapting to changes. In particular, the decisions by firms to scale up existing activities or invest in new activities, even when these decisions result in failure, are helpful, as they allow evolutionary learning both for the failing firms (provided the business environment allows them to re-enter with renewed access to financing following efficient bankruptcy proceedings) and for the enterprise sector as a whole (provided that the business environment has mechanisms in place to facilitate such positive learning and spillovers).³⁰ However, absent appropriate policies, enterprise reallocation and innovation can lead to a concentration of productivity gains in a small number of formal firms in only one or a few industries, and insufficient spillovers and economy-wide learning – with negative broader impacts including an insufficiently resilient enterprise sector with not enough creative destruction across industries (see Box 3).

Box 3. Israel's software development: Insufficient spillovers leading to a less resilient "dual economy".³¹ As documented by Trajtenberg (2009), Israel's pre-2000 innovation policies largely benefited its ICT (Information and Communications Technology) and especially software industry. It provides a compelling illustration of how innovation-driven growth is not necessarily resilient and inclusive. It also provides valuable lessons in the design of more diversified (across industries and hence less risky from an economy-wide perspective) and more inclusive innovation policies. By the late 1960s, Israel had reached what may now be termed a middle-income trap: the big waves of immigration had subsided, and though Israel had few natural resources, it had highly skilled manpower and scientific and technological prowess. The question facing policymakers was how to mobilize these assets for faster growth. Public support policies, together with other contributing factors, resulted in growth of 16% per year in the ICT industries during the 1990s, with ICT exports growing over the 1990s by a factor of 6 and accounting for one third of total exports. However, in many other industries, TFP actually declined on an annual basis between 1996 and 2004, including transportation (-0.4% per annum), construction (-2.0%) and retailing and business services (-3.3%), leading to a dual economy with a large share of the benefits flowing to firms and consumers abroad. Trajtenberg argues that this was in large part due to inappropriate policies that focused on: (i) product innovations rather than also on other types of process, design and organizational innovations; (ii) exports rather than benefits for the rest of the economy; and (iii) local MNC labs only serving the global needs of the parent companies located outside the country. A key conclusion is the desirability of avoiding narrowly-targeted policies, and instead for policies to be directed at fostering spillovers to the rest of the local economy, ensuring wherever possible that the

³⁰ See Taleb (2012).

³¹ In addition to Trajtenberg (2009), on which this box draws heavily, see also Teubal and Kuznetsov (2012).

generation of knowledge, its destination and its ultimate economic impact are inclusive, responsive to the broad needs of the local economy – across households, geography, and industries.

III.2 Impact on people

Efficient reallocation and innovation by enterprises can also, supported by appropriate policies, positively affect the risk management of all people, including: lowering the volatility to firms of returns from production and to people of consumption expenditures by providing a diversified mix of products; helping people absorb shocks and provide a steadier stream of income and employment; alleviating the resource constraints that limit people’s own risk management possibilities through higher incomes afforded by enhanced productivity; and directly addressing health and safety risks.

III.2a. Impact on people as consumers

To what extent do reallocation and innovation decisions by enterprises in response to short-term shocks and longer-term changes in demand and supply trends allow the enterprise sector to make the best use of available resources to meet consumer needs, both in aggregate terms and across different income groups? Bartelsman, Haltiwanger and Scarpetta (2013) examine this question in aggregate terms through a model calibrated to developed and developing country enterprise-level data with permanent and transitory enterprise-specific productivity and distortion shocks.³² Their analytical framework allows for two different channels through which distortions affect aggregate output and consumption, namely both resource reallocation within industries across enterprises of different productivity levels as well differing paces of firm selection (entry and exit of enterprises of differing levels of productivity). In the presence of distortions, the enterprises with the highest productivity no longer have the highest market shares, outputs and inputs, and some highly productive enterprises with a “bad distortion draw” will exit while some low productivity enterprises will be able to operate, leading to a further misallocation of inputs. A higher dispersion in distortions worsens selection based on productivity and lowers the overall efficiency of resource allocation across operating enterprises, reducing enterprise sector output and consumption by households. They show how the improved selection and size-productivity relationship in Central and Eastern European economies as their transition to a less distorted market economy progressed in the 1990s is associated with a substantial increase in consumption.³³

³² The inclusion of idiosyncratic, enterprise-specific distortion shocks –interpreted broadly to include any distortion that impacts the scale of a business– is consistent with evidence that certain regulations apply *de jure* differently to enterprises of different sizes (such as rules affecting the hiring and firing of workers applying only to enterprises above a certain size threshold in a number of countries), whereas other regulations are *de facto* enforced unevenly across enterprises of different sizes, industries, and rent-seeking opportunities.

³³ Holding the distribution of plant productivity fixed, Hsieh and Klenow (2009) provide suggestive evidence that resource misallocation between existing plants can account for about one-third of the gaps in aggregate manufacturing TFP between the US and countries such as China and India. In Hsieh and Klenow (2013), they show that another type of misallocation that punishes large plants lowers the productivity of the average plant in India and Mexico. Both types of distortions are important in reducing aggregate output and consumption by households. Based on a panel of enterprises in Ghana, Kenya and Tanzania, Soderblom, Teal and Harding (2006) find that TFP does not impact on survival of small firms, suggesting that there is no process of sorting or selection by which the more efficient firms survive and grow, again reducing aggregate output and consumption (see also Teal 2013).

Acemoglu and colleagues (2013) examine the impact of enterprise reallocation and innovation decisions on aggregate consumption through a complementary general equilibrium model that allows enterprises to differ in their degree of innovativeness and allows exit to be driven by creative destruction (innovation by other firms replaces the leading-edge status of a firm in a particular product line), an exogenous disaster shock, and obsolescence (firms with sufficiently low productivity endogenously exit from product lines). Their model highlights that the decentralized allocation calibrated to US enterprise-level data does not maximize growth or aggregate welfare in consumption equivalents. Indeed, their striking finding is that the allocation that a welfare-maximizing social planner would choose results in a 70% increase in the growth rate (growth increases from roughly 2.2 to 3.8%) with welfare in consumption equivalents increasing by 6.5% relative to the market-based decentralized outcome. A first reason for the divergence between decentralized and efficient equilibria is the traditional knowledge externality and underinvestment in R&D (and some other types of KBC) associated with enterprises not being able to appropriate the full value of new innovations, including the productivity increases to other firms from the increased stock of knowledge. But a more important second reason is a substantial inefficiency in the decentralized equilibrium arising from selection effects: low productivity, low innovation-capacity firms remain active too long because they do not take into account that by freeing resources from the fixed cost of operations for these firms, skilled labor can be reallocated and combined with R&D (and other KBC-related) inputs – which is not fully internalized by the market because the skilled wage is depressed relative to its social value. So even when their model is calibrated to a relatively well-functioning economy like the US, there are substantial growth and consumption gains from even faster exit of low-innovation capacity firms and faster entry of high-innovation capacity firms than in a market-based outcome. This suggests significant untapped benefits for consumers from business environments that facilitate more enterprise innovation-related risk-taking, experimentation and learning.

Absent appropriate policies, market incentives for reallocation and innovation can also result in the product and quality mix remaining tilted toward higher-income consumers with the ability to pay, with innovative products that enable improved risk management by the poorest people not being developed or marketed.³⁴ Illustrative examples of inclusive innovation that enable improved risk management by poor people and may not take place absent some appropriate policy intervention include:

- the novel use of rice husks in India for rural electrification or solar lighting – reducing the fire hazard and health risks from the fine particles in the fumes associated with kerosene-fuelled lanterns, and broadening the risk-absorption capabilities of household members by facilitating home study and other productive activities at night)³⁵
- the use of solar panels to power an electrochemical toilet that turns human sanitation waste into useful things such as chlorine (a disinfecting solution used to flush the toilet), hydrogen (suitable for cooking or powering a fuel cell to produce electricity) and residue (used as fertilizer) – this toilet, winner of the Gates Foundation “Reinventing the Toilet” \$100,000 first prize, will if widely

³⁴ See Dahlman and Kuznetsov (2013) for a categorization of different types of base-of-the-pyramid (BOP) innovation and relevant policy issues. Their working definition of BOP innovation is any organizational and or technical novelty that is likely to be broadly diffused and have an impact on the welfare and living standards of low-income households through the consumption channel. They do not discuss how innovation helps the BOP population through its impact on income earners through jobs and increasing earnings, or as owners of even small amounts of capital.

³⁵ See “Energy technology: Cheaper and better solar-powered electric lights promise to do away with kerosene-fuelled lanterns”, *The Economist*, September 1, 2012.

deployed, help prevent the risk of the 1.5 million childhood deaths from diarrhea that now occur each year, in addition to reducing the risk of other diseases associated with untreated and exposed human waste³⁶

- other products that allow consumers to mitigate the risks they face, such as shifting from entire families precariously clinging to motor bikes and exposing themselves to severe accidents to “frugally engineered” low-cost small cars with seatbelts,³⁷ and shifting to healthier fruit and vegetable diets from high-sodium, high-fat, high-sugar diets exposing consumers to obesity, diabetes and chronic heart disease.³⁸

Absent appropriate policies, market incentives for reallocation and innovation also can result in negative safety and environmental impacts of the production and consumption of goods and services not being sufficiently addressed. Illustrative examples of adverse safety and environmental impacts that may take place absent some appropriate policy intervention include:

- Non-earthquake-proof houses and schools absent appropriate construction standards and their effective enforcement, as highlighted by China’s earthquake in Sichuan province in May 2008 that killed approximately 70,000 people (including thousands of children crushed to death by collapsing school buildings) and by Turkey’s north-western earthquake in August 1999 that killed approximately 25,000 people (with older buildings remaining standing but newer buildings built on shallow foundations with cement mixed with too much sand literally pulverized by the impact of the tremor).³⁹
- The explosion on the Deepwater Horizon oil rig in the Gulf of Mexico in April 2010 due to inadequate preventive measures triggered one of the largest oil spills in history, while there have been approximately 2,400 fresh oil spills involving foreign energy companies in the 2006-2010 period alone in the Niger Delta that contains Nigeria’s vast oil and gas reserves. The impact of the Gulf of Mexico spill on oyster fishermen alone has been significant, with oysters possibly taking as long as ten years to recover, fishing boat captains no longer having customers, and associated enterprises laying off almost all their staff. Pollution from oil spills has also devastated the fishing industry in the Niger Delta, though the perception is that “one bad spill in the West is getting more attention than half a century of irresponsible oil production in the Delta” – linked to the problem that Nigeria has plenty of environmental laws but few are enforced.⁴⁰
- Overuse of antibiotics is leading to loss of potency and furthering the spread of antibiotic-resistant bacteria, with the number of infections that are resistant to treatment by antibiotics on the rise, a

³⁶ See “Technology and development: Each year 1.5 m children die from diarrhea. Better toilets could reduce the death toll”, *The Economist*, September 1, 2012; and Ramani et al. (2011).

³⁷ See “A brilliant, cheap little car has been a marketing disaster”, *The Economist*, August 20, 2011.

³⁸ Years of healthy life lost from being overweight as a percentage of years lost to all chronic disease, at over 30%, was already significantly higher in Oceania and Middle East & North Africa in 2010 than in North America and Western Europe. The Vitality Group, part of a health insurance company in South Africa, finds ways to pay people to eat more fruit and vegetables and exercise, getting its money back because it pays fewer medical bills. See “The big picture: Obesity special report”, *The Economist*, December 15, 2012.

³⁹ See “The Sichuan earthquake: Bereaved parents treated like criminals”, *The Economist*, May 14, 2009, and “Lessons from Turkey: After the horror, there could be changes for the better”, *The Economist*, August 26, 1999.

⁴⁰ See “Deepwater Horizon: Mopping up the legal spill”, *The Economist*, March 3, 2012, “Nigeria’s oil: A desperate need for reform”, *The Economist*, October 20, 2012, and “Oil in the Niger Delta”, *The Economist*, June 25, 2010.

problem that is compounded by falling incentives for global drug companies to develop more resistant antibiotics especially for diseases affecting the poorest.⁴¹

III.2b. Impact on people as income earners

One of the most important ways that the enterprise sector helps people manage risk is through the steadier and rising incomes provided by the employment of their human capital and other assets, which in turn allows them to consume a range of better risk management products. Reallocation and innovation can deepen and widen product and factor markets, creating more resilient and productive development outcomes. Productivity levels have important implications for the ability of enterprises to manage risk and offer stable and steadily increasing employment. Bartelsman, Haltiwanger and Scarpetta (2013) show, in their empirically-calibrated model with productivity and distortion shocks, that the enterprise sector in countries with fewer distortions and higher productivity also employs more workers, and uses more capital.

Efficient reallocation and innovation can benefit people as stakeholders in enterprises (investors, entrepreneurs, workers), with different types of enterprises playing different roles in creating jobs and other asset employment opportunities depending on the prevailing business environment. Acemoglu et al. (2013) show, in their empirical examination of the forces jointly determining resource allocation, innovation and productivity in the relatively low-distortion US business environment, that young firms are both more R&D intensive, grow more and create more jobs.⁴² These growth rate differences across enterprise size types, and in particular the higher growth rates for young start-up enterprises conditional on survival, conform to more general patterns for economies with low distortions (Haltiwanger et al. 2013).⁴³

However, these patterns do not appear to persist in countries with significant market and policy distortions, and with a significant number of informal enterprises. Hsieh and Klenow (2013), based on time series data that capture the large informal sector (as well as the formal plants) in Mexico and India as well as in the US, show that while the average young plant that enters in the US increases employment more or less smoothly over time to a ten-fold increase by age 35, in Mexico employment only witnesses a

⁴¹ See “The Dangers of Hubris on Human Health” in World Economic Forum (2013), where one cited study found that 98% of children with the common cold at a Beijing hospital were given antibiotics (useless for treating viral infections), since drug prescriptions is their main income generator (Yezli and Li, 2012), with strong antibiotics sold over-the-counter in pharmacies or in local marketplaces in India without a prescription, leading to significant inappropriate self-medication – while strong antibiotics should be a last line of defense, pharmacy sales in India increased nearly six-fold in India from 2005 to 2010 (Westly, 2012). The slowdown in the development of new antibiotics is linked, among others, to the greater potential return on drugs to treat chronic illnesses such as diabetes and hypertension, diversion of attention to new life science technologies such as nano-scale engineering and synthetic biology, and the high cost of regulatory burdens for clinical trials.

⁴² This matches the empirical findings from a large literature on firm age and innovation, where younger and smaller enterprises tend to produce more innovations per unit of research resources (Akcigit 2010).

⁴³ The main finding of Haltiwanger et al. (2013), based on comprehensive data tracking all enterprises and plants in the US non-farm business sector for the period 1976 to 2005, is that there is no systematic relationship between enterprise size and growth, once enterprise age is controlled for. They document an “up or out” dynamic for young enterprises in the US. Young firms are more volatile and exhibit higher rates of both gross job creation from entry and expansion and gross job destruction from exit. But conditional on survival, young firms grow more rapidly than their mature counterparts. Their findings show that small, mature businesses have negative net job creation.

two-fold increase by age 25 and then remains unchanged after that, while in India average employment actually falls to one-fourth of its level at entry by age 35.⁴⁴ The steady growth of surviving enterprises in the US results in the bulk of employment being concentrated in larger, older (and more productive) plants, in contrast to Mexico and India, where employment is concentrated in smaller, young (and less productive) plants; since average wages are higher in larger plants (not only in the US but also in Mexico and India), this leads to fewer workers in Mexico and India benefiting from higher wages.⁴⁵ They show that low average employment growth in Mexico and India can largely be attributed to low TFP growth with age. They then show that resource misallocations that punish large plants can discourage investments that raise plant productivity (and job creation and wage growth).

It has long been recognized that innovation impacts employment through multiple channels of varying time scales and complexity, and that the overall effect is sensitive to the character of the innovation (process versus product, radical versus incremental, etc.) and its setting. Process innovation can lead to productivity gains which enable firms to produce the same level of output with fewer inputs, including direct labor-saving impacts or “displacement effects”. However, these direct negative effects of process innovation on employment can be counterbalanced by indirect expansion impacts or “compensation effects” when the cost reductions from the innovation spur price reductions to drive higher demand and greater output. Product innovation, on the other hand, generally leads to “market-expansion effects” when it stimulates domestic and foreign demand for the firm’s outputs, thereby enhancing labor demand for the innovating firm. However, both product and process innovation can cause demand diversion from substitute products of other firms, or “business-stealing effects”, and thereby have an uncertain impact on aggregate employment (depending on the relative strengths of market-expansion and business-stealing effects). How these countervailing impacts of innovation on employment balance in practice is an empirical question, depending on the nature of the technology employed, the substitutability of input factors, the own- and cross-price elasticities of demand, the degree of competition in the relevant product market, the nature of the business environment, the type of process innovation, the degree of novelty of the new product, and a host of other factors.⁴⁶

⁴⁴ These patterns hold across many industries and for formal and informal plants alike. Growth in average employment of a cohort is driven by survivor growth and/or by the exit of smaller plants. Hsieh and Klenow show that what appears to differ between US and India is the growth of incumbents: in the US, surviving plants experience substantial growth while in India incumbent plants become smaller with age.

⁴⁵ Older plants in the US (more than 40 years old) account for almost 30% of total employment in the US, while they account for less than 10% of employment in Mexico and India; in contrast, less productive plants less than 10 years old account for 50% of employment in Mexico and India, while they account for roughly 20% of total employment in the US. Plants (informal and/or family-owned) that only employ unpaid workers account for 72% of employment in India in 1989-90, while the employment share of family plants has increased in Mexico from 10% in 1998 to almost 30% by 2008.

⁴⁶ Using data on German manufacturing and service-sector firms from the third Community Innovation Surveys (CIS3) for the period 1998-2000, Peters (2005) finds that product innovations have a net positive impact on employment while process innovations are associated with employment reduction for manufacturing but not service firms. These findings are largely confirmed by Harrison et al. (2008) in a study that is also based on CIS3. Using comparable firm-level data across four European countries —France, Germany, Spain, UK— they find that process innovation has significant displacement effects that are partially counteracted by compensation mechanisms. The displacement effects of process innovation are most pronounced in manufacturing. On the other hand, product innovation is associated with employment growth and these results are similar across countries. Based on a firm-level comparison across provinces and cities in China, Mairesse et al. (2009) find that the compensation effects of product innovation more than counterbalance the displacement effects of process innovation, the net result being

In a recent paper, Dutz et al. (2012a) debunk a conventional view that innovation is not inclusive in the sense that the benefits are presumed to flow only to skilled workers and shareholders of technically sophisticated companies. They provide support for a contrasting view that innovation should be interpreted as applying to a broader range of entrepreneurial activities, including the introduction of products and processes that are new-to-the-firm. Based on firm-level data of over 26,000 manufacturing enterprises across 71 countries, they show that enterprises that innovate in this broader sense employ a higher share of unskilled workers, a higher share of female workers, and attain higher TFP and more rapid employment growth than firms that do not innovate. In particular, when enterprises experience the positive spur that comes from the ability to expand by accessing competitive markets, product and process innovation and increased TFP make expansion profitable: the ensuing output expansion creates job growth that is not biased away, but rather is generally tilted towards inclusion of the unskilled. Across all countries, unskilled workers constitute 34% of the share of the employees of the combined group of product and process innovative firms, versus 30% for non-innovative firms. A 10% increase in the share of unskilled workers is associated with an employment annual growth rate that is almost 1% higher for innovative firms than for non-innovating firms, and the difference is quantitatively important over time. Also, across all countries, innovative firms' employment of female workers is 29% versus 22% for non-innovative firms, and again the employment growth rate of innovative firms is greater than for non-innovating firms where the share of female workers is greater. Importantly, our finding that innovating firms employ a higher share of unskilled and female workers than non-innovating firms does not imply that their income is higher, or their income growth is faster, than the skilled – as even though innovating firms hire a larger share of unskilled workers than non-innovating firms, their share is still significantly lower than skilled workers. And they may be receiving significantly lower pay and lower income growth, questions that our data unfortunately did not allow us to address. However these findings, coupled with the increasing empirical support in the literature for the view that low-wage jobs are a stepping stone for the integration of the jobless into employment and better-paid work in the future, do provide a key underpinning to innovation-driven inclusive growth.⁴⁷

No matter how efficient the reallocation and innovation patterns in any given country's enterprise sector, employment and wages will fluctuate especially for workers in those firms that contract or go out of business and in new businesses that are launched and expand. And the introduction of new skill-biased and labor-saving technologies can lead to widening employment opportunities and earnings differentials between skilled and non-skilled workers, and to technological (structural) unemployment – creating three overlapping sets of losers (Brynjolfsson and McAfee 2011): (1) low-skilled workers (technologies often displace routinized tasks and increase the value of more abstract and data-driven tasks, enhanced by complementary changes in work organization technologies); (2) “non-superstar” workers (in some winner-take-all or winner-take-most industries, a few highly-talented people get the lion's share of rewards); and (3) owners only of own-labor (to the extent that technology reduces the relative importance

that innovation makes a strong positive contribution to total employment growth. Alvarez et al. (2011) find that in the case of Chile, process innovation is generally not a relevant determinant of employment growth, and that product innovation is positively associated with employment growth.

⁴⁷ A number of recent papers have sought to ascertain empirically whether low-wage employment is a stepping stone that enhances future occupational advancement prospects, or whether it results in a low-pay-no-pay poverty trap cycle. Although the evidence is somewhat mixed and subject to debate, there seems to be greater support for the stepping-stone effect. For analysis of the pathways of upward mobility for low-wage workers, see among others Booth et al. (2002), Knabe and Plum (2010) and Mosthaf (2011).

of labor, owners of capital will capture a bigger share of income from production). The level and fluctuation of employment and wages, in particular affecting these groups of workers, can be reduced when the enterprise sector is more flexible and labor contracts are more enforceable, and appropriate support policies are in place to address inevitable adjustment frictions affecting displaced workers.

IV. WHAT IS THE ROLE OF PUBLIC POLICY?

This section discusses interventions addressing the double externalities of knowledge- and risk-related market failures compounded by traditional externalities in areas such as more inclusive and greener development where market prices do not reflect societal values.

Appropriate types of government support will depend, among others, on the prevailing technological capabilities and adjustment costs in the enterprise sector's locality and industry.

Governments should help create business environments that stimulate entrepreneurial risk-taking to invest in market and social opportunities that combine new technologies with appropriately-skilled workers. To help address the mismatch between accelerating (exponentially-growing and global) technologies versus relatively stagnant (linearly-advancing and local) skills, labor market institutions, organizational know-how and regulatory frameworks, there is a strong role for policies that promote entrepreneurship and organizational innovation and foster skill development – with entrepreneurs having the lead role in inventing new business models that can leverage evolving technologies and make the most productive and remunerative use of available pools of labor (Brynjolfsson and McAfee, 2011).

Policies should reflect a better understanding of the relative importance of different types of KBC in affecting the four pillars of risk management (knowledge, protection/enabling, insurance and coping/leveraging), and in turn the relative importance of the four pillars in managing different types of risks across different types of industries and countries. Importantly, the case for policy intervention should demonstrate that costs associated with implementation and with any government failure from policy action are outweighed by the benefits from addressing the market failures. In the case of KBC, key market failures that create a possible rationale for policy actions include knowledge spillovers, increasing returns to scale in production, path dependencies, and efficiency-cum-distributional effects. A well-understood market failure is the non-rivalrous nature of knowledge, namely that most types of KBC involve development costs that are not re-incurred when that knowledge is used again, leading to its desirable spillovers and re-use by as many as possible on efficiency grounds – but also to possible underinvestment in new knowledge generation to the extent that the initial enterprise may not be able to fully appropriate the returns to the investment. The increasing returns nature of costs can foster enterprise growth but may also raise specific competition policy concerns. And to the extent that shared prosperity is an explicit national goal, markets will typically not on their own, absent appropriate policy intervention, result in the most able entrepreneurs investing in the types of KBC that are most likely to achieve efficient growth and shared prosperity. A simple illustration, adapted from Banerjee and Duflo (2005), is the reality that less able high-income entrepreneurs will be able to self-invest in lower-efficiency skills upgrading, networking/global collaboration and project outcomes, while more able low-income entrepreneurs may not be able to similarly invest in higher-efficiency skills upgrading, networking/global collaboration and project outcomes.

IV.1 Spurring entrepreneurial experimentation

Policymakers have an important role to play in creating an enabling environment for entrepreneurs to take risks, experiment and learn. Possibly the highest risk to the enterprise sector in any country is maintaining a business environment with high exit costs and low levels of risk-taking, as there is then no impetus for rapid reallocation and innovation. Key policy imperatives are to set the appropriate rules of the game for the allocation of entrepreneurial talent towards innovation, including reducing distortionary “costs of success” and “costs of failure”, and ensuring sufficiently flexible and competitive product and factor markets with as much policy certainty and as little policy arbitrariness as possible.

Policy can influence the allocation of entrepreneurship more effectively than it can influence its total supply. By establishing or altering the prevailing “rules of the game”, policy plays a key role in specifying the relative payoffs to different entrepreneurial activities that determine whether these people develop and use these talents and most critically how they allocate their entrepreneurial talent and effort: whether entrepreneurship will be directed to destructive activities (e.g. war lords or drug barons), to unproductive activities (e.g. public sector rent-seeking by creating and taking advantage of protection from competition and monopoly rents, and private sector rent-seeking including through insider dealing, unproductive tax evasion, litigation and societally-inefficient corporate takeovers), or to socially productive activities, namely efficiency-enhancing reallocation and innovation (Baumol 2010).

Distortionary “costs of success” inhibiting risk-taking and growth include a high likelihood of expropriation of the rewards of innovation and a range of related policy barriers. One of the most important sets of rules to stimulate the allocation of entrepreneurial talent toward innovation activities is to ensure, through contract enforcement and rule of law, that successful innovators are allowed to reap generous rewards commensurate with the risk undertaken, that entrepreneurs are permitted to grow and accumulate wealth without a high risk of expropriation by other firms or by the state (including through excessive taxation, various forms of corruption, or dominant firms denying expansion opportunities through illegal means if the young growing firms are too successful), and that the respect for such rules is widely followed and trusted throughout society. Based on evidence from India and Mexico, Hsieh and Klenow (2013) suggest that the return on investments in plant-specific intangible capital (KBC) to boost within-firm TFP may be lower in Mexico and India than in the US due a range of market and government distortions punishing enterprise expansion — such as higher tax enforcement and/or corruption,⁴⁸ difficulties in obtaining skilled managers and/or bigger contractual frictions in hiring non-family labor,⁴⁹

⁴⁸ In Mexico, Levy (2008) argues that payroll taxes (roughly 32% of the wage bill) are more stringently enforced on large plants, as are other taxes (Anton, Hernandez and Levy, 2012). Indian labor regulations, applying more strictly to larger firms (or that small formal and informal firms find easier to evade), are emphasized by Besley and Burgess (2004). La Porta and Shleifer (2008) document that larger formal plants spend more on bribes (as a share of revenue) than do smaller formal and informal plants.

⁴⁹ Bloom et al. (2013a) argue that delegation costs raise the costs of managers in India, supported by models where managerial inputs are important for large plants but less important for smaller formal or informal plants (see the appendix in Hsieh and Klenow 2013). The fact that the gap in average wages between large and small plants in Mexico and India is almost twice that observed in the US also suggests that larger plants in Mexico and India may pay higher efficiency wages due to monitoring costs or that the cost of skilled managers is higher there.

difficulties in buying land to expand,⁵⁰ higher costs of shipping to distant markets,⁵¹ and finance frictions.⁵² Such barriers encourage firms to stay informal/small and not invest sufficiently in innovation-enhancing and risk-mitigating types of KBC, so policy has an important role to play in addressing these barriers.

Distortionary “costs of failure” that increase the costs required for entrepreneurs to try out commercializable ideas also inhibit risk-taking experimentation and growth, with higher exit costs acting as entry barriers. Distortionary costs include excessively strict bankruptcy regulations and the inability to borrow again in formal financial markets after bankruptcy, high labor hiring/firing costs, the inability to share high-fixed cost facilities or the absence of sufficiently deep lease, rental or resale markets (including for essential business services such as power and IT-serviced business premises),⁵³ and the negative social stigma associated with failure (not viewing failure as a critical learning mechanism and as a likely by-product of high-risk activities). Policy should address these barriers, as well support information dissemination such as the documentation and widespread diffusion of role models of successful high-risk taking local entrepreneurs.

The welfare effects of lowering barriers to entrepreneurship depend on more than the impact on the level of entrepreneurship and should take into account how individuals select into entrepreneurship and how these firms behave *ex post*. If individuals self-select into entrepreneurship only if the return they perceive overcomes the cost of entry (the “self-selection view”), reducing entry costs leads to a worsening in the pool of entrepreneurs since the marginal entrepreneurs have worse characteristics than incumbents. If, on the other hand, individuals only learn their abilities by trying to start a business (the “experimentation view”), reducing entry barriers will draw in constrained individuals who may have even better entrepreneurial abilities than incumbent unconstrained entrepreneurs. Hombert and colleagues (2013) evaluate a large-scale French policy action implemented in 2002 that lowered entry costs by reducing potential entrepreneurs’ “costs of exit”, namely providing “downside protection” by allowing unemployed individuals to retain their rights to unemployment benefits in case their venture fails. The reform also provided insurance against cash flow shortfalls by mandating the insurance fund to pay out any gap between their entrepreneurial revenues and their unemployment benefits. Their findings confirm that this form of lowering the “costs of exit” did indeed spur entrepreneurial experimentation, and is consistent with the “experimentation view”: they find a very large effect of the reform on business creation across industries, with a 25% increase in monthly creation rates after the reform was implemented, and with wages and productivity larger in the newly-created firms when compared with “shrinking” incumbents. And even though the crowding-out effects in terms of jobs destroyed in existing small incumbents offset most of the direct job creation effects of lowering entry barriers, the labor reallocation process had a

⁵⁰ Hsieh and Klenow (2013) provide evidence that the average product of land is rising with plant size in India: this could be evidence of technological differences (if larger plants use less land-intensive techniques) but it can also be evidence that frictions to land reallocation raise the marginal cost of land faced by high-productivity plants.

⁵¹ Holmes and Stevens (2012) show that larger plants sell to more distant domestic markets. Hsieh and Klenow (2013) provide a model in their appendix where higher shipping costs per unit of distance lower the number of markets a firm with a given productivity serves, which lowers the returns from investing in higher productivity.

⁵² Cole, Greenwood and Sanchez (2012) also construct a quantitative model to fit the same facts for the US, Mexico and India, where financing frictions inhibit incumbent technology adoption in Mexico and India.

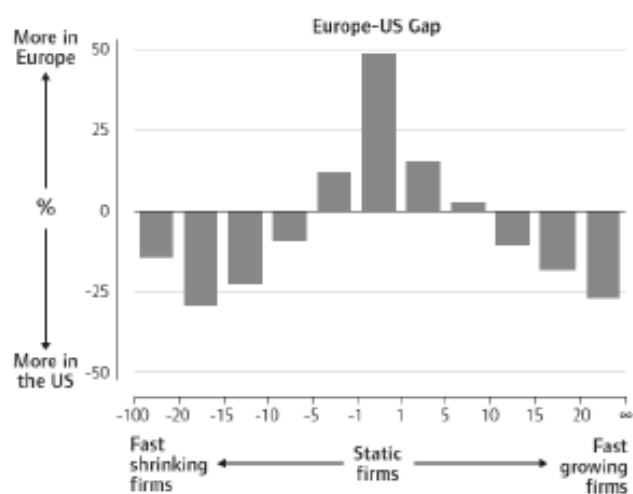
⁵³ Cooper and Haltiwanger (2006) highlight that “the irreversibility of many projects caused by a lack of secondary markets for capital goods acts as an important form of adjustment cost.”

positive net impact on aggregate productivity since the newly-created firms were on average more productive.

Box 4 reviews recent empirical findings on the importance of policies ensuring sufficiently flexible and competitive product and factor markets. Recent findings by Acemoglu and colleagues (2013) on the special importance of selection effects when taking into account both reallocation and innovation — namely that faster exit and entry rates than in market-based outcomes are desirable to allow resources to flow to high innovation-capacity firms— would suggest the desirability of a policy of actively encouraging the exit of low innovation-capacity incumbent enterprises by taxing their operating costs or subsidizing their exit, or more realistically taxing all incumbents’ operating costs and thereby leading the least cost-efficient ones to exit.

Box 4. Flexible product, labor, financial and R&D markets and bankruptcy laws that do not overly penalize failure raise the expected returns of investing in KBC. There are stark differences in business growth dynamics across countries as reflected in enterprises’ heterogeneous reallocation and innovation responses to exogenous shocks – driven by underlying differences in the enabling environment.⁵⁴ Data covering the whole distribution of firm employment growth across both manufacturing and non-manufacturing industries show clear differences in the process of reallocation and innovation across countries, with the US displaying a higher level of business dynamism (with both faster growing and

Figure 3: Distribution of enterprise employment growth, 2002-05



Source: Bravo-Biosca et al. (2012)

⁵⁴ High-income countries for which these data are available include the US, Canada and eight European countries (Austria, Denmark, Finland, Italy, Netherlands, Norway, Spain, and the UK). The data provide measures for the percentiles of the growth distribution for surviving enterprises with ten or more employees during 2002-05, as well as the share of enterprises growing or shrinking at a particular rate. The data only include surviving firms (defined as those that have survived with positive employment throughout the 3-year period), so do not allow analyses of entry and exit patterns or of the contribution of entry and exit to aggregate employment growth. However, the data do capture the reallocation and innovation processes that enterprises undertake, including jobs lost by firms that dismiss employees in response to external shocks or if innovations don’t turn out as anticipated, as well as spinouts that reduce the headcount, and on the upside organic growth and acquisitions. See Bravo-Biosca et al. (2012).

shrinking firms) than most continental European countries (Figure 3). Across countries, high-growth firms (HGFs) make a disproportionate contribution to employment growth: HGFs account only for between 3.6 and 6.4% of all surviving firms, yet they account for between 25.5% (Austria) to 64% (UK) of all jobs created by surviving firms. However, non-HGFs still account for between 1/3 and 3/4 of job creation (and the underlying reallocation and innovation), highlighting the need to consider the full growth distribution when designing policies to foster desirable reallocation and innovation.

This and related studies highlight the importance for reallocation and innovation of:

(1) flexible product market (entry and competition) regulations, with less stringent regulations in manufacturing industries associated with higher allocative efficiency, and reforms in services markets regulations having stronger effects on resource allocation when labor and credit markets are more responsive (Andrews and Cingano 2012)

(2) flexible labor market regulations, lowering the costs of downward adjustment, spurring greater risk taking, faster job reallocation and increasing productivity growth in R&D intensive and labor-intensive sectors, with firms less willing to expand their workforce or enter into new markets if they cannot reduce their workforce later if their reallocation and innovation decisions prove unsuccessful (Andrews and Criscuolo 2013, and Bartelsman et al. 2010 and 2013)⁵⁵

(3) more developed financial markets, regulations that encourage banking competition and an efficient judicial system that enforces contracts on the growth distribution of firms, boosting the growth of the best performing firms and speeding up the contraction of underperforming firms in industries highly dependent on external finance (Dutz et al. 2012a)⁵⁶

(4) bankruptcy laws that are not excessively stringent, as they impose high exit costs in the event of business failure and therefore may make entrepreneurs less willing to experiment with risky technologies; with more debtor-friendly bankruptcy codes being associated with more rapid technological diffusion, enabling countries to catch-up with the technological frontier (Westmore 2013).⁵⁷

Importantly, R&D fiscal incentives may have the unintended consequence of protecting incumbents and slowing down the reallocation of resources towards more innovative entrants. Fiscal incentives for R&D, a market-based tool intended to support R&D activities that otherwise would not have taken place by reducing the marginal cost to firms of R&D activities, are increasingly being used in developing countries (including Brazil, Chile, China, India, Poland, Russia, and Turkey), in addition to being widely used in

⁵⁵ Bartelsman et al. (2010) describe how firing costs reduce the incentive for firms to attempt adopting risky technology, impeding flexibility to be able to reorganize operations to best fit the technology (firms that turn out to be unsuccessful in adopting new risky technologies need to be able to avoid deep losses, otherwise the incentive for adoption is lost). More generally, any regulation that becomes more burdensome at some size threshold is shown by Bartelsman et al. (2013) to generate significant welfare losses from misallocation.

⁵⁶ Based on an econometric analysis of over 26,000 manufacturing enterprises across 71 countries, Dutz et al. (2012a) find that countries with a more competitive business environment (measured by Doing Business variables interpreted as reflecting access to key essential business services, especially access to credit and to registering property) are associated with more innovation and more inclusive-type job creation. Access to information (Internet use) and formal job training are much more important to the employment growth of young enterprises than they are to other categories of enterprises.

⁵⁷ The direction of the link between bankruptcy regimes and innovation is less clear-cut and varies according to the capital intensity and the dependence on external finance of the industry, as loose bankruptcy regulation with weaker creditor rights also attenuates the creditors' insurance effect and thereby increases the cost of raising external finance. For a review of recent empirical evidence, see Andrews and Criscuolo (2013).

developed countries (Estonia, Finland, Germany, Mexico, New Zealand and Sweden do not employ R&D tax incentives). Based on a general equilibrium model calibrated to US data, Acemoglu and colleagues (2013) caution against subsidization of all R&D activities based on the one market failure of underinvestment in R&D. In comparison to a relatively non-distorted business environment, they show that subsidies to incumbent enterprises (or equivalently higher exit costs) reduce growth, consumption and welfare: a subsidy to incumbent R&D equivalent to 5% of GDP reduces aggregate welfare by 1.5% in consumption equivalent terms because it deters entry of new high innovation-capacity firms. The policy has a negative selection effect, with an adverse impact on both incumbents and potential entrants, reallocating resources from more- to less-efficient enterprises since it directly helps only those firms that are near the lower end of the product quality/innovation distribution and at the exit margin, namely disproportionately low-productivity enterprises – further depressing innovation. Due to the importance of selection effects in their model, it turns out to be much better to support entry and incumbent R&D by freeing resources such as skilled labor from inefficient low innovation-capacity incumbents by taxing their operating costs or subsidizing their exit (or more realistically taxing all incumbents' operating costs, leading the least cost-efficient ones to exit) than to subsidize entry or incumbent R&D directly. In addition, R&D subsidies may mainly increase the wages of inelastic inputs rather than innovation (Romer 2001 and Wilson 2009), and may be ineffective when other complementary investments such as basic science are not also in place and subsidized (Akcigit, Hanley and Serrano-Velarde 2012). In support of these views, recent OECD studies find no correlation between R&D tax incentives and TFP growth at the aggregate level (Westmore 2013) and a negative correlation in more R&D intensive sectors, with more generous R&D tax credits being associated with a higher share of stagnant firms and a lower share of shrinking firms, slowing down an otherwise more efficient reallocation process (Bravo-Biasca et al. 2012).

IV.2 Supporting skills upgrading

Inappropriate reallocation and innovation decisions can have dire short and long-term impact on people. Enterprises worldwide together with education systems have not performed adequate investment and reallocation decisions given the persistence of the twin crises of a shortage of jobs and a shortage of skills: 75 million youth are unemployed worldwide, with young people three times more likely than their parents to be out of work, representing not only a huge pool of untapped talent but a long-term underinvestment in human capital and a source of potential social unrest and individual despair. In addition, half of youth are not sure that their post-secondary education has improved their chances of finding a job, and almost 40% of employers say a lack of skills is the main reason for entry-level vacancies (Mourshed et al. 2012).

As a second area of policy action, policymakers should support more knowledgeable and skilled risk-taking by people within individual enterprises and as part of urban agglomerations. While a KBC focus invites a re-examination of the priorities of all types of government policies, perhaps the most important area concerns the importance of appropriate human capital policies, given that human capital underpins KBC. Appropriate policies that balance skills supply and demand become even more essential, as do the need for such policies to be even more demand-driven by the current and anticipated future needs of employers, with education/training curricula and apprenticeships that produce workers that enterprises want to hire supported by PPPs (Hulten 2013, OECD 2013). Key policy imperatives are to support

investments in human capital and facilitate people to invest in themselves through enterprise-driven on-the-job and vocational training, and to support agglomeration of enterprises and people for enhanced knowledge spillovers, in particular urban agglomerations that attract, retain and spur interaction of talent.

Based on an analysis of more than 100 education-to-employment initiatives from 25 countries (selected on the basis of their creativity and effectiveness), and a survey of youth, education providers, and employers in nine countries that are diverse in geography and socioeconomic context (Brazil, Germany, India, Mexico, Morocco, Saudi Arabia, Turkey, the UK and the US), Mourshed et al. (2012) argue that a big part of the skills policy solution is to oblige educators to step into employers' shoes and employers' to step into educators', and students to move between the two – by reinventing vocational and on-the-job training, with two promising trends. First, technology is greatly reducing the cost of vocational education with a range of replicable models including:

- “serious games” facilitated by computer technology advances provide young people with a chance to gain virtual hands-on experience at minimum cost
- Colombia’s Labor Observatory provides details on the graduation and employment rates of every educational institution in the country, disseminating information about education and employment demand, and thereby empowering students to select programs leading to good pay, and incentivizing schools to become more relevant to the workplace (and improving flow of information to manage risk via more rigorous and continuous monitoring and evaluation).

And second, private and public sector institutions are coming up with ideas to improve vocational training, with agreements between private sector employers and community colleges pulling the educational curriculum towards market needs. Recent examples include:

- Korea has created a network of vocational schools, labeling students as “young meisters” in order to counteract the country’s obsession with academic laurels (from the German for ‘master craftsmen’)
- China Vocational Training Holdings specializes in matching students with jobs in the Chinese car industry by keeping masses of data on both students and companies
- Mozilla (creator of the Firefox web browser) has created “open badges initiative” that allows people to get recognition for programming skills (importance of certification to signal quality of training)
- IL&FS Skills gives Indian students a job guarantee if they finish its courses, with training contracts helping to deal with poaching externality (Almeida et al., 2012).

Another policy area ripe for joint federal and local reforms in coordination with the private sector is the urban dimension of entrepreneurship and absorptive capacity development, namely the enhancement of the livability and “stickiness” of cities, to attract and retain talent. Recent evidence shows that local agglomerations of firms in specific technology areas, which likely increase technology and supply-chain spillovers, also reduce income uncertainty of skilled workers (Ellison et al. 2010) – which puts a premium on appropriate urban policies as part of desirable skills upgrading policies.

International experience suggests that much of the absorption of existing frontier technologies and the nurturing of technological advances are likely to be concentrated in a few metropolitan regions. Half of the productivity growth recorded by the US between 2000 and 2008 was by 20 metropolitan areas, with these cities accounting for 40% of GDP (McKinsey 2011). The shift in population as workers move from rural agriculture to urban areas that facilitate face-to-face learning and creative interactions between young entrepreneurs, skilled people, and institutions connected to global knowledge should help unleash

innovation (Glaeser 2011). Dense urban-industrial cluster agglomerations have been vital for technological upgrading and productivity growth by opening opportunities and stimulating supplies of capital and skills. China's establishment of special economic zones, followed by a range of support by national and local governments for further industrial deepening in its three major urban/industrial agglomerations (the Pearl River Delta centered on Shenzhen, Dongguan and Foshan, the Yangtze River region around the Shanghai-Suzhou axis, and the Bohai region in the vicinity of Beijing and Tianjin) and in a number of the inland cities (including the footwear cluster in Chengdu and the Wuhan optoelectronics cluster) highlights how a mix of instruments can be employed together, including science parks and extension services, encouragement of local universities to establish industrial linkages, attracting a major local or foreign anchor firm that can trigger the in-migration of suppliers and imitators, and above all dense transport and communication connectivity infrastructure (Yusuf, Nabeshima and Yamashita 2008).

IV.3 Promoting joint learning through global collaboration

As a third area of policy action, policymakers should ease enterprises' investments in lower-risk new-to-the-firm adaptive innovations (versus typically longer gestation and higher risk new-to-the-world frontier innovations) by creating a business environment that facilitates the local diffusion, capture and adoption of existing global knowledge, enables local firms to collaboratively improve on existing technologies, and supports collaborative risk sharing. Key policy imperatives include facilitating firms' joint learning through global collaboration by connecting to and learning from global value chains, universities and their extended communities, the relevant national diaspora, supported by open data platforms to pull global knowledge towards meeting the neglected needs of poorer segments of populations, allowing them to better confront and manage their risks.

Based on recent analyses of processes of technology diffusion across countries and over time, Comin and Mestieri (2013) highlight that over 70% of the variation in per capita income today across countries can be accounted for by differences in how quickly technology diffuses both across and within countries, with the intensive margin or within-country component responsible for most of the difference. Differences in the extensive margin of technology adoption (differences across countries in the timing of the adoption of new technologies after their invention, that is, whether or not a technology is adopted at all by a country) account for roughly 25% of the cross-country variation in TFP. Importantly, newer technologies such as cell phones, Internet usage, and MRIs have been adopted faster than old ones such as electricity and telephones, reflecting benefits of globalization. An additional 45% of the cross-country variation in TFP can be attributed to differences in the intensive margin, namely how quickly and how many units of the technology are adopted within-country for a given size economy, given that it is adopted. While the cross-country dispersion in adoption lags had declined significantly over the last two centuries, Comin and Mestieri (2010) find no such convergence pattern in the intensive margin. Comin et al. (2012) report evidence that geography plays a significant role, with technology diffusing slower to locations that are further away from the adoption leaders. However, this effect is stronger across high-income countries. This suggests that better understanding of why within-country diffusion has been so slow in lower-income countries could be critical in helping reduce differences in cross-country income per capita, including a better understanding of the relative importance of different drivers of the intensive margin such as absorptive capacity and adoption costs (including historical endowments such as the quality of the

education system and familiarity with related technologies), institutional constraints that affect the overall efficiency of the economy (e.g. expropriation risk), and distortions that affect the price and incentives to invest in physical capital and KBC.⁵⁸

In a suggestive study, Fogli and Veldkamp (2012) explore how different social structures might affect a country's rate of technology diffusion and progress. Based on the idea that communicable diseases and technologies spread in similar ways, through inter-personal contact, they explore an evolutionary model where limited connectivity reduces the risk of an infection entering the social group, allowing people to live longer, but also restricting the group's exposure to new ideas, slowing technology diffusion and inhibiting growth.⁵⁹ The network model, which explicitly addresses the intensive margin of adoption, explains why societies with a high prevalence of contagious disease might evolve toward low-connectivity, growth-inhibiting social institutions, and how small initial differences can produce large divergence in incomes. A main finding is that a 1-standard deviation increase in connectivity between people increases TFP by an amount equal to 23% of US productivity: these numbers imply, for example, that the difference between high-connectivity Finland and low-connectivity Ghana explains just under half of the difference in their technology diffusion rates, and just over one-third of their per capita output gap.⁶⁰ An explicit promotion of global collaboration via global consortia and other mechanisms to facilitate within- and cross-country connectivity and collaboration between people and enterprises that otherwise would not have interacted may be called for. It could be interpreted as tilting prevailing social structures towards global collaboration growth-enhancing social networks that speed the diffusion of new ideas and technologies, and that help better manage risks. This is especially important in environments where the risk of germ infection is now less than the risk of foregone ideas that otherwise would impede more efficient risk management (see Boxes 5 and 6).

Box 5. Policies to spur collaborative risk-sharing for innovation: Combining technology-push with market-pull support, underpinned by open data policies. Traditional technology-push public R&D grants to researchers at US NIH-type national research councils, universities and public labs face a number of challenges, such as allocating resources to the best researchers⁶¹, the need to reduce systematic

⁵⁸ Both Comin and Hobijn (2010) and Comin and Mestieri (2010) rely on data on the diffusion of 15 important technologies in 166 countries over the last two centuries.

⁵⁹ In his 1969 AEA presidential address, Kenneth Arrow observed: "While mass media play a major role in alerting people to the possibility of an innovation, it seems to be personal contact that is most relevant in leading to its adoption. Thus, the diffusion of innovation becomes a process formally akin to the spread of an infectious disease".

⁶⁰ Fogli and Veldkamp (2012), pp 31-2. Results are based on data on the prevalence of 34 diseases in 78 geopolitical regions (the countries with the highest pathogen prevalence are Brazil, China, Ghana, India and Nigeria, with the lowest include Canada, Hungary, Switzerland and Sweden), and a survey by Hofstede (2001) on national differences in cultural values reflecting degrees of collectivism (where low-connectivity societies where people from birth onwards are integrated into strong, cohesive in-groups, often extended families, with people averse to breaking those ties, and with weak or non-existent global ties are labeled collectivist, and high-connectivity societies with strong global ties are labeled individualistic; the most collectivist countries are Ecuador, Guatemala, Indonesia, Pakistan and Venezuela, while the most individualist are Australia, Canada, the Netherlands, the UK and the US).

⁶¹ Nicholson and Ioannidis (2012) ask whether the US National Institutes of Health award its grants to those most likely to make fundamental breakthroughs in their fields (based on biomedical researchers who studies received more than 1,000 citations), and find that only 40% of such high-impact primary authors who are not part of study sections (experts in the fields in question who hand out the grants) currently receive NIH grants. This finding that too many US researchers of the most innovative and influential papers in the life sciences do not receive NIH funding is supported by a second finding that study sections appear to favor work similar to that done by their

error in published research and ensure the transparent dissemination of all research results (including “negative results” that fail to support the hoped-for hypothesis)⁶², and ensuring that the research itself is responsive to some relevant societal need. In an effort to push researchers towards entrepreneurship, programs such as Singapore’s National Research Foundation NFIE (National Framework for Innovation and Enterprise) have provided funds to develop academic entrepreneurship in institutes of higher learning, including proof-of-concept grants and a technology incubation scheme. These efforts on their own have not been as successful as anticipated, no doubt due to the difference in temperament and skills of most academics versus entrepreneurs. Building on the recent successes of university entrepreneur-in-residence programs in the US, an interesting policy direction would be to provide seed funding for entrepreneurs interested and able to partner with researchers in technologies that they perceive have the highest potential for commercialization. Such policies would be a natural complement to university TTOs (technology transfer offices), but instead of pushing researcher-developed technologies out to the market, they would help by bringing the imperative of market needs to bear on which research projects get additional funding, by facilitating market-savvy entrepreneurs to partner with the developers of technologies at a sufficiently early stage so that their R&D trajectory could still be modified at relatively low cost to better meet market needs. In addition, to help researchers, entrepreneurs, users and civil society at large better assess the promise of new technologies, global public policy should support an open data platform for all emerging research results (ideally even including “negative results” from corporate-funded clinical trials), curated to highlight what has been learned including how perspectives or hypotheses should be modified in light of all available data.⁶³

Box 6. Policies to support affordable innovations: Learning from global collaboration and local experience. There appear to be significant benefits from global collaboration supported by “contracting

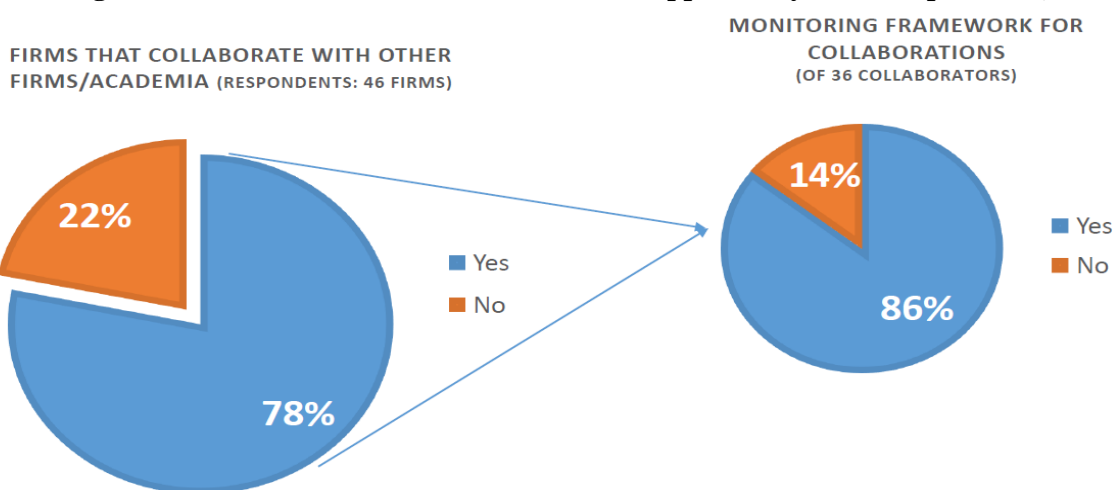
existing members or that they recruit members with similar interests to themselves, and whose citation impacts typically were classed as ‘good’ or ‘very good’ but not ‘exceptional’.

⁶² It is well-known that errors are part of science. However, examining what fraction of published biomedical research findings turn out not to be true in the light of further research, Ioannides (2005) shows that for most study designs and settings, it is more likely for a research claim to be false than true. In particular, the greater the financial and other interests and prejudices in a scientific field, the less likely the research findings are to be true. As an illustration, researchers at a US-based human therapeutics company were able to confirm the results of only six of 53 ‘landmark studies’ in preclinical cancer research (Begley and Ellis, 2012). As another illustration regarding the higher risk of heart attacks from the use of a top diabetes drug (in September 2010, the FDA announced major restrictions on the use of the drug with European regulators ordering it off the market on the same day; a US FDA scientist later estimated that the drug had been associated with 83,000 heart attacks and deaths), each of the 11 authors of the drug’s clinical trial had received money from the company (four were employees and held company stock). Interviews, FDA documents and emails released by a US Senate investigation indicated “that the company withheld key information from the academic researchers it had selected to do the work; decided against conducting a proposed trial because it might have shown unflattering side effects; and published the results of an unfinished trial even though they were inconclusive and served to do little but obscure the signs of danger that had arisen” (Whoriskey 2012). In July 2012, the company pleaded guilty to criminal charges and agreed to a \$3 billion settlement of the largest health-care fraud case in the U.S. and the largest payment by a drug company in the US. The settlement is related to the company’s illegal promotion of best-selling anti-depressants and its failure to report safety data about this diabetes drug.

⁶³ Transparency about all research, including industry-sponsored trials, would allow independent researchers and potential entrepreneurs to analyze the data and come to their own conclusions. As stated by Yale Professor of medicine Harlan Krumholz, a leading advocate of open data access, “If you have the privilege of selling a drug [or any other product], in return should come the responsibility to share everything you know about the product” (quoted in Whoriskey 2012).

for innovation” based on “diagnostic monitoring” (systematic error detection and error correction for continuous improvement of processes pioneered by the Toyota production system), especially in high-risk rapidly changing industries such as biotech, ICT, and contract manufacturing (where the ability to respond quickly to demand fluctuations—to bear the risk of either over or under-capacity—is central to the package offered to customers). Non-state-contingent contracts or governance mechanisms for long-term collaborative innovation appear particularly desirable in situations where the parties cannot specify *ex ante* what innovations would become necessary or feasible, or could be produced at a cost-effective price; they typically include agreed milestones to measure and monitor performance, mechanisms for deterring on-going opportunism and build trust among collaborators, and processes for dispute resolution.⁶⁴

Figure 4: India biotech firms – Collaboration supported by research protocols, 2012



Source: Dutz and Vijayaraghavan (2013).

Since its creation in 1986 by India’s Ministry of Science and Technology, the Department of Biotechnology (DBT) has been actively initiating and supporting global product development consortia between local and foreign closer-to-the-frontier firms, universities and public research organizations, including an Indo-Swiss Collaboration in biotech applied to agriculture (with over USD 33 million in public investment since 1974), the Indo-US Vaccine Action Program (with over USD 20 million in public investment since 1987), a partnership with Wellcome Trust for affordable healthcare (with over UK£ 45 million in public investment committed since 2010), and bilateral consortia with Australia, Canada, Denmark, Finland, Germany, Japan, Norway, Sweden and others. These consortia have been vehicles for investment in KBC and learning by Indian firms, not only about intellectual property but about “how-to” tacit knowledge regarding structured research protocols that help mitigate risk. Suggestive evidence of the positive spillovers of such learning are provided by a recent survey of Indian biotech enterprises recipients of public support. Interestingly, 55 percent of respondents reported that they directly address

⁶⁴ As described by Gilson et al. (2008), transactions involving collaborative innovation across organizational boundaries are characterized by product characteristics design and specification not being able to be contracted *ex ante*. A desirable contracting structure should (i) induce efficient investment by both parties, (ii) establish a framework for iterative collaboration and adjustment of obligations under continuing uncertainty, and (iii) limit the risk of opportunism that otherwise could undermine relation-specific investments.

the needs of Base of Pyramid people in the lowest income groups. Based on survey results, Indian biotech firms may have been learning over time not only about international product knowledge but about the benefits of co-creation through partnerships and structured research protocols: 36 of 46 surveyed biotech firms (78%) indicated that they collaborate with other firms or academia for co-development (Figure 4). More tellingly, 31 of these 36 firms (86%) reported jointly monitoring progress and results via structured research protocols, including in their contracts or informal agreements governing their partnerships one or more of: (i) common data sharing processes, (ii) commercialization-driven milestone-based incentives, (iii) monitoring via joint review processes, and (iv) well-defined escalation mechanisms for dispute resolution.

DBT's support of global consortia is part of a broader systematic approach to learn and build on existing global knowledge and thereby avoid the higher risks of frontier innovation. Policy support also included (1) a focus on translational research, namely where interdisciplinary teams focus on translating existing basic science findings to practical commercializable solutions through adaptation and verification to meet local needs, supported by the set-up of dedicated facilities configured to promote cross-disciplinary collaboration with more interaction than usual between academic research and industry practice;⁶⁵ (2) support of domestic PPPs for early-stage funding of SMEs and viability gap funding for larger higher-risk projects; (3) skills development; (4) strengthening of the regulatory framework; and (5) institutional governance, including the set-up of Special Purpose Vehicles (SPVs) to govern the global consortia.

A notable outcome to-date is India's first indigenously-developed oral vaccine to prevent high infant mortality from rotavirus-caused diarrhea.⁶⁶ The project was supported by India's product development consortia with the US (Indo-US Vaccine Action Program), received support from India's two domestic PPP programs for early-stage funding and for viability gap funding, as well as being supported by other Product Development Partnership (PDP) members.⁶⁷ It is the first time that an Indian company is bringing a vaccine successfully through phase III trials, India's first community clinical trial conducted directly through doctors and clinics, with the licensed vaccine to be sold to governments worldwide including UN procurement agencies at a price of \$1 – and once widely distributed, dramatically reducing the risk of further deaths from this disease.⁶⁸

Finally, a new and as-yet-insufficiently-tried innovation policy that may hold promise in a range of areas addressing global public goods which impose higher risks on developing countries such as climate change

⁶⁵ The setting up in early 2009 of the Translational Health Science and Technology Institute, south of Delhi, modeled on the interdisciplinary Harvard-MIT Health Science and Technology Program, was specifically designed to foster collaboration among research institutes, hospitals and companies by encouraging practicing doctors to work with basic researchers and engineers to solve local health problems.

⁶⁶ An estimated 130,000 infants still die annually in India from severe rotavirus gastroenteritis.

⁶⁷ Other PDP members, in addition to Bharat Biotech, the Indian company headquartered in Hyderabad, include: AIIMS (all India Institute of Medical Science, Delhi), IISc (India Institute of Science, Bangalore), PATH (Program for Appropriate Technologies in Health), the Atlanta Center for Disease Control, Stanford University, and the Bill and Melinda Gates Foundation. While the PDP model arose to address the mismatch between the need for health technologies to address developing country needs and the private sector's inability to meet that need profitably due to the costs and risks of such R&D being too high relative to ability to pay, it could in principle be applied to a range of BoP needs ranging from agriculture and education to climate change.

⁶⁸ On the most recent status of the "Phase III Clinical Trial to Evaluate the Protective Efficacy of Three Doses of Oral Rotavirus Vaccine (ORV) 116E (ROTAVAC)", see <http://clinicaltrials.gov/show/NCT01305109>.

and neglected diseases involves fostering genuinely global consortia by building on existing bilateral consortia. As an illustration, Canada created in 2011, as a new element of its Networks of Centers of Excellence program, a bilateral Canada-India Research Center of Excellence (CIRCE) initiative. CIRCE recently announced the award of CAD 13.8 million in funding over five years to a consortium of Canadian and Indian universities, public sector research agencies, private-sector partners, and not-for-profit and non-governmental organizations.⁶⁹ The objective is to meet research objectives and create substantial impact in strategic areas such as alternative cleaner energy, water quality and resource management, advanced materials and sustainable urbanization, and other aspects of environmental sustainability. Once the fixed costs of setting up initiatives like this are incurred, it would require relatively little additional cost to enrich and globalize such bilateral consortia by including to existing platforms other appropriate participants, such as a relevant university researchers, private sector corporate researchers and entrepreneurs from other countries. CIRCE has indicated interest in complementing their bilateral consortium with relevant multilateral additions. The policy challenge is how best to fund such add-on initiatives, how best to identify and bring in the most appropriate complementary global talent, and how best to support the global dissemination and commercialization of the research findings.

V. CONCLUSION

This paper has presented an initial exploration of the role of different types of KBC and the role of appropriate policies in supporting enterprise risk management, in particular reallocation and innovation decisions in response to changing demand and supply trends and unexpected shocks. It has argued that the increased flow and management of knowledge permitted by investments in KBC can be an important factor in reducing the decision risk facing enterprises due to uncertainty and imperfect information. It has highlighted that, absent appropriate policies, KBC investments can have adverse distributional effects on the enterprise sector and on people – including a skewed industrial concentration of productivity gains, and more unequal consumption and income-earning outcomes between rich and poor people. A key message is that insufficient enterprise risk-taking can be costly for the enterprise sector and the economy, as it results in too little experimentation and learning. And that policy has an important role to play in creating business environments that stimulate entrepreneurial experimentation, support skills upgrading, and promote mechanisms for joint learning through global collaboration.

Looking forward, there remains an important policy research agenda across countries with different levels of technological and institutional capacities and industrial structures to better understand the magnitude of investments in different types of KBC, their importance for enterprise risk management and impact on the enterprise sector and on people as consumers and income earners, and policy implications.

Regarding measurement, efforts are needed to collect better comparable data across developing countries by national governments supported by capacity building of national statistical agencies, at the level of both national accounts and individual firms (including farms and informal and formal non-farm enterprises). This work should be accompanied by testing and eventual systematic inclusion of additional national enterprise census and survey questions related to investments in different types of KBC and enterprise risk management. Regarding analysis and experimentation, it would be helpful to better

⁶⁹ See http://www.nce-rce.gc.ca/Media-Medias/news-communiqués/News-Communique_eng.asp?ID=120

understand the linkages between investments in different types of KBC by both formal and informal enterprises, the channels through which capabilities in enterprise-level risk management are improved, and their impact on productivity and jobs dynamics as well as shared prosperity, including the extent to which productivity increases are shared through more and better-paid jobs over time. For example, do increases in investments in particular types of KBC by enterprises in a given industry result in lower volatility in earnings of these enterprises over time relative to that same industry in other countries, and are there important spillovers across enterprises within and across related industries? And how does it differ across different types of industries? Regarding policy actions, it would be helpful to develop more tailored recommendations for countries with different endowments and at different stages of development. What is the impact of increased enterprise exit and entry and experimentation on displaced workers, and what policies are best at both spurring entrepreneurial experimentation while easing adjustment costs associated with failure of enterprises and displacement of people? Further work is also required to determine the extent to which different constraints to investment and use of different types of KBC are binding at different times, including under what circumstances more productive enterprises are more likely to expand and create more jobs. This could provide more useful recommendations regarding the pace and sequencing of policy actions. And finally, it will be important also to include in the design and implementation of policies specific approaches to measure how effective the policies actually are, so that not only the enterprises are learning, but policymakers and policy advisors are learning as well.

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